Innovating for sustainability

with case studies from the organic dairy industry, the fish processing industry and the car industry

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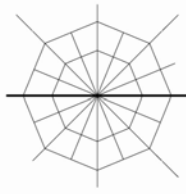

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Preface

The theme of this Working Paper is 'Innovating for sustainability'. The article of Remmen & Holgaard gives an overview of different positions within innovation and network theory, and on that basis a framework is developed and discussed in relation to environmental innovations. Empirically, the paper highlights how enterprises within the organic dairy industry and the fish processing industry have made environmental innovations related to their processes and products. The articles from Smink, Jørgensen & Nielsen, Jørgensen & Smink and Smink deal with environmental innovations in the car industry. In the article of Smink, Jørgensen & Nielsen it has been analysed how the environmental policy of parent companies (BMW and General Motors) affects the environmental strategy of their South African assembly plants. The aim of the article of Jørgensen & Smink is to present and discuss some of the empirical findings regarding Environmental Management Systems (EMS) of four companies in the automotive industry in South Africa. EMS can be viewed as a travelling concept that is appropriated to different contexts. The concept of environmental management is shaped due to conditions such as interests and demands of different stakeholders, the regulatory framework, market structure, organisational identity, educational systems, accreditation bodies, available equipment and production facilities. Finally, the article of Smink deals with end-of-life vehicle regulations. Focus is on the European End-of-Life Vehicle Directive (2000/53/EC) and how Denmark and the Netherlands have dealt with end-of-life vehicle regulations in the last 30 years.

Aalborg, September 2004

Carla Smink

Environmental innovations in the product chain

By Arne Remmen & Jette Egelund Holgaard

Abstract

Innovation is a distributed process involving several stakeholders, especially in Denmark with a lot of small and medium-sized companies. The enterprises are very much dependent on collaboration and knowledge sharing within the product chain as well as close relations to the knowledge and regulatory network. For environmental innovations the development in the environmental discourse has made this characteristic more conspicuous considering the product oriented environmental policy. Theoretically, the paper gives a brief overview of different positions within innovation and network theory, and on that basis a framework is developed and discussed in relation to environmental innovations. Empirically, the paper highlights how enterprises within two different trades in the Danish food industry have made environmental innovations related to their processes and products. An investigation has been made with in-depth case studies of seven dairies producing organic milk and of ten fish processing industries. The internal characteristics of the enterprises have been analysed related to environmental understanding, management style and the most important environmental innovations in a five-year period. Besides, the inter-organisational relations of the firms are analysed in a network context. Furthermore, the cases will be discussed in relation to the institutional set-up, the inter-organisational relations, actors in the product chain, the flows of materials and services, values and money, communication and collaboration in the two product chains.

The importance of creating long-term inter-organisational learning has received increasingly attention in innovation and network theory to cope with dynamic and more global business conditions. An investigation of organisations in Europe and North America showed that supply chain networks are becoming increasingly complex and global and their management is becoming an increasingly important business issue (Kielkiewicz-Young & Young, 2001).

In a Danish context, technology competencies and customised products play an important role in the competitiveness of Danish industry. Furthermore, there is a high degree of small and medium sized companies, and as Håkansson (1987) points out co-operation is one way for these companies to mobilise external resources lacking within the specific company. In many ways Danish companies are thereby forced to cope with innovation as a distributed process between several actors in the product chain, as well as in the knowledge and regulatory network of enterprises.

In the specific case of environmental innovations, the co-operation in the product chain is important to secure innovations of cleaner products, as an improvement in one part of the product

chain can cause environmental problems in another part of the product's life cycle. In this line, Kerndrup et al (2003) view environmental management and planning as a polycentric activity, taking place in settings of knowledge and capabilities dispersed on many actors. Furthermore, experiences from environmental innovations in product chains show that innovative solutions are developed by communicative acts between similar and complementary fields of practice (Kerndrup, 2002).

In this paper, co-operation in the product chain will be exemplified through empirical case studies of environmental innovations in the dairy and fish processing industries respectively. The empirical material presented in the paper is based on the POET-project (Product innovation, Organic food, Environment and Technology). The aims of the project were to make an investigation of Danish food industries regarding:

understanding and concepts of sustainable food production,

the factors influencing the innovation of new food products, and the possibilities for expanding the quality concept to include concerns for the environment, etc

development of methods to integrate environmental concerns in the whole life cycle of food products, including life cycle assessment, screening and design criteria,

collaboration and communication in the product chain and in the knowledge network in the sector about environmental issues and development of food products.

This paper will especially focus on environmental innovations and product chain collaboration. The theoretical framework for considering collaboration in the product chain within the food industry is drawing on innovation and network theory taking a learning perspective as the point of departure.

Collaboration in the product chain – a conceptual framework

In general, innovation theory has moved towards a higher emphasis on innovation as an interactive process (see Lundwall, 1998). The term systems of innovations established in the collective work on “Technology and Economic Theory” (Dosi et al, 1988) highlight relationships and interactions between agents from inside and outside the product chain. These relationships were presented as organised markets with elements of power, trust and loyalty (Lundwall, 1985). The system of innovation approach can be further described in the following way (Edquist, 1997):

“The innovation process is characterised by complicated feedback-mechanisms and interactive relations involving science, technology, learning, policy and demand. Innovation processes occur over time and are influenced by many factors. Because of this complexity, firms almost never innovate isolated. In the pursuit of innovation they interact with other organisations to gain, develop and exchange various kinds of knowledge, information and resources.”

Recently, innovation theory has put more focus on processes of learning and the importance of the companies' capabilities to collaborate. Lundwall (1998) argues that there is an increasing need for social capital to follow the trajectory of globalisation. Among others he refers to Woolcock's definition of two basic elements of social capital in considering the micro level: Firstly, the need to combine strong internal cohesion (integration) and, secondly, the openness to the outer world (linkages). Woolcock (1998) also points out that there is a need to see these two elements as combined.

Furthermore, it is important to analyse *the type of innovations*. According to Freeman (1992) a theory of innovation must embrace both the innumerable incremental innovations and the radical discontinuities. In the case of incremental innovations the changes can be expressed as change in the input and output of *existing* products and processes. Radical innovations cause structural change in the economy and ultimately lead to entirely new industries. Radical innovations set new demands to skills, the organisation and different types of production equipment.

Besides distinguishing between incremental and radical innovations, it can be pointed out whether the innovation activity emphasises changes in the production processes or in the product – commonly referred to as process or product innovations. This view must, as Freeman (1992) also note, be seen in relation to other kinds of technological changes referring to changes in the knowledge base and the organisation. The framework of collaboration in the product chain covers these issues.

Network theory has also moved towards a learning perspective, as described in more details by Hagedoorn and Duysters (2002). In the efficiency perspective on networks it has been argued that there is a diminishing utility of added linkages in general because of the increase of redundant information. Instead focus is on the utility for adding the "right" kind of linkages to well-established stakeholders. In contrast, a learning perspective on networks takes a different point of departure. Here the scope of the interactions is not to collect existing knowledge, but to learn different ways of doing things, and the high status player may not be the most relevant connection in that concern. Actually, a variety of sources may be an advantage in seeking new potential partners and alternative solutions.

Kerndrup et al (2003) talk about networks of practice as loose coupling of people working with the same type of practice but in different settings – their day-to-day practice is not connected. There is so to speak a cognitive distance between the actors in the network. Therefore, it is rather complicated to bring communicative acts across fields of practice, because there is a need for a common frame to translate complex and ambiguous information and knowledge in a way that makes sense in different fields of practice (Kerndrup et al, 2003).

In this perspective the focus is not only on the actors involved in the network, and the flow of materials and values in the product chain. The focus is more process-oriented emphasising the chain of activities connecting the actors and the transfer of situated experiences between different organisational settings.

This understanding of communication and collaboration in the product chain can be illustrated in the following way, defining the main actors involved as well as the activities (see figure 1).

The framework is inspired by Christoffer (1998) who defines supply chain management as a network of collected and independent organisations mutually and co-operatively working together to control, manage and improve *the flow of materials and information* from suppliers to end users (Christoffer, 1998). Besides, the framework is similar to the definition of Integrated Supply Chain Management (ISCM) used at Massachusetts Institute of Technology where ISCM is seen as a process oriented, integrated approach to procuring, producing and delivering products and services to consumers covering the management of *material, information and funds* (Metz, 1998).
In these perceptions, the flow of information is viewed in a traditionally way focusing on data exchange and delivering of orders.

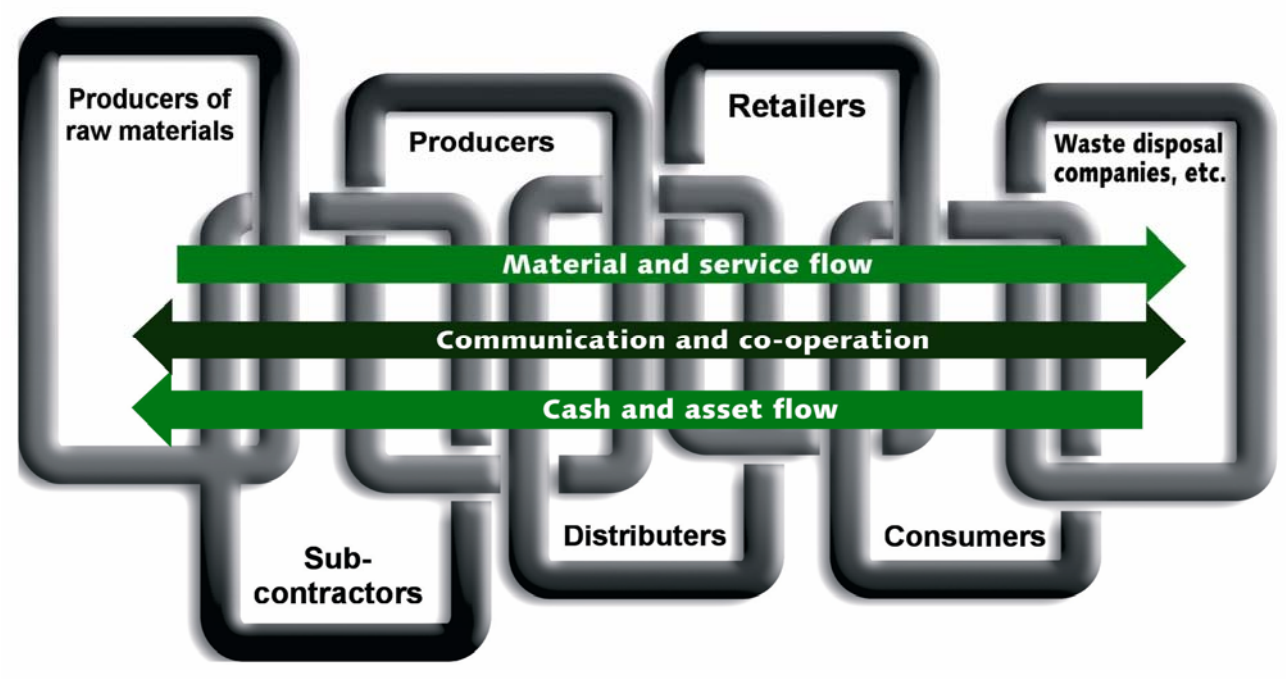

Figure 1: Communication and collaboration in the product chain (Remmen & Münster, 2003).

The notion of communication and collaboration in the product chain in figure 1 expresses a more learning based understanding involving the ongoing process of experience exchange and coordination of the activities in the product chain. Informative means like environmental product declarations, eco-labelling, etc. are documentation of the material flow and a necessary but not sufficient condition for collaboration on environmental issues. As pointed out above, collaboration requires dialogue and communication in order to create a common meaning, a mutual understanding and trust.

Another source of inspiration has been Håkansson (1982 & 1987) who defines three different but closely interrelated networks: the network of resources, activities and actors (Håkansson, 1987). The activity- and actor-network highlights the understanding of flows between actors as an exchange of practices and experiences beyond information exchange.

The actors in the product chain can in this perspective be seen as a network of interested parties that at one point in the product chain has an ownership or a responsibility for the product, whether it is connected to semi-manufactured articles, materials, the end-product, or services.

The network of activities is closely related to the flows of materials and values. But as Håkansson points out the human resources of knowledge and relations are also a part of this network, which makes it necessary to focus on the dimension of communication and collaboration as in figure 1. Another interesting point is the concept of exchanging episodes used in describing short term relations, where long-term relations are defined as institutional adaptations, which can be seen in parallel to the notions of communication and collaboration.

Håkansson (1982) points to the importance of viewing the interaction between organisations in their context, and in describing this context he distinguishes between the inter-organisational *atmosphere* and the surrounding environment. The atmosphere is defined within the inter-organisational sphere considering the power/dependence, co-operation, closeness and expectations. In defining the *environment* Håkansson uses market structure, dynamism, internationalisation, position in manufacturing channel and the social system as constituting factors.

Finally, Søndergaard et al (1997) have highlighted that a product chain or the business network as they call it has to be seen in relation to the knowledge and the regulatory network, see figure 2. This approach has inspired a redefinition of what Håkansson calls “environment” to the institutional context as constituted by the institutions of regulation and knowledge. However, the business network has an institutional set-up of its own, as Håkansson points out by referring to the market structure. In this context we will use the more comprehensive notion of market institutions.

This rather short introduction has highlighted the following concepts in order to investigate collaboration in a product chain:

The institutional set-up of the product chain is constituted by the regulatory, knowledge and market institutions.

The actors in the product chain are seen as a business network of interested parties, who at one point are transforming or adding value to the product, and who have different kinds of knowledge and capabilities.

The flows of resources are including the flow of materials and services downstream and a value and money flow upstream the product chain.

Communication and collaboration are interactive processes in order to exchange, document and co-ordinate the activities in the product chain, and which involve learning.

The inter-organisational conditions are constituted of power relations/dependency, co-operation, closeness and expectations as well as trust, loyalty and credibility.

Environmental innovations as network activities

From the mid 1990's it was recognised that the environmental efforts within the companies were not sufficient, as the main environmental problems were regarded to be the general resource consumption in society and the impacts from the use of products (Wenzel, et al, 1996). Beside production, other phases in the lifecycle of products were highlighted, such as extraction of materials, transportation, use and recycling of products.

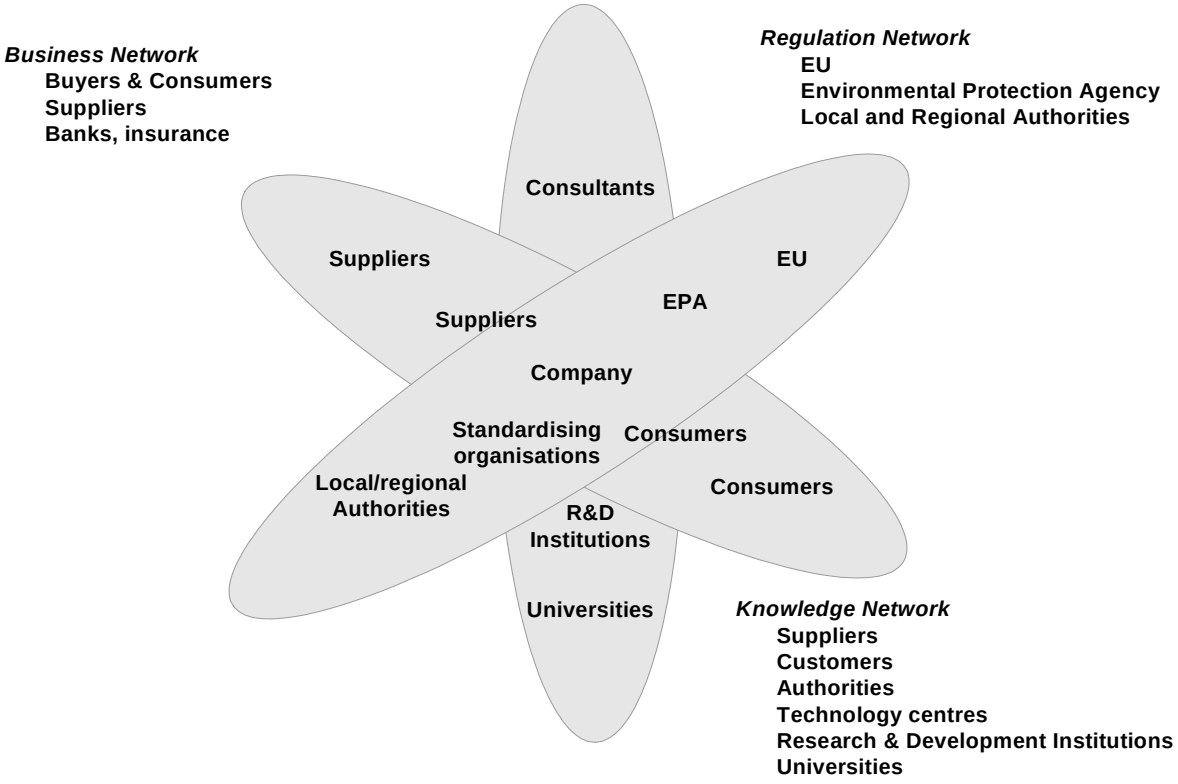

Figure 2: The business, regulation and knowledge network (Søndergaard et al, 1997).

As for the types of innovations focus has changed from mainly process innovations towards product innovations, and to some extent there is an increasing awareness that some environmental problems e.g. related to transportation can only be reduced through radical and systemic innovations.

The environmental discourse has changed from a focus on the environmental impacts from production to lifecycle management (LCM) focusing on impacts in the whole life cycle of the products. Cleaner production, environmental management and life cycle assessment are together with product chain and network co-operation the cornerstones in LCM (Remmen, 2001). The life cycle perspective confronts the companies with new challenges, as the environmental initiatives have to be co-ordinated throughout the product chain.

Life cycle management can be seen as an umbrella for different concepts trying to capture the product chain dynamics related to environmental innovations. Responsible chain management is one notion, defined as managing issues of responsibility across the life cycle where responsibility is based on sincere expectation to act in a desired way (de Bakker & Nijhof, 2002). The focus is the capability to meet the interests of the stakeholders, but social, environmental and ethical dimensions are also connected to this concept. Another notion is sustainable supply chain management (see Charter, 2001) emphasising that the environmental and social aspects have to be seen together with the economic aspects of purchase. Hall (2000) uses the term environmental supply chain dynamics to show how environmental innovations diffuse from firms putting demand to their suppliers.

In the following we will line up some characteristics of changes in the environmental discourse in relation to the framework developed in the previous part.

The institutional set-up

Awareness of environmental problems and solutions is constantly undergoing changes as a result of inadequacy of the previous approaches and in recognition of new problems and possibilities. Until recently, the awareness of environmental problems mainly focused on resource use and emissions from the production process like smoke, waste and noise. However, the environmental awareness has increasingly been extended to cover the entire production system and the product life cycle, including the choice of materials and design, transport, as well as the use and disposal of products.

In a Danish context, regulatory institutions like the Danish Environmental Protection Agency (DEPA) have focused on different means in order to improve the environmental performance of industry, and have furthermore supported the capacity building of a knowledge network consisting of consultants, universities, etc. The institutional set-up has – until recently – improved the conditions for environmental innovations of cleaner processes and products in the firms (Remmen, 2000).

However, the focus in the product oriented environmental policy in Denmark in the mid 1990's has had a point of departure in a rather instrumental platform, emphasising the development of tools for life cycle assessment, and informative means like ECO-labelling, guidelines for including environmental criteria in public procurements, etc.. The main assumption has been: If the enterprises have the right tools, they will develop cleaner products. If the consumers – including public purchasers – have the right information they will buy and increase the demand for cleaner products.

However, practical experiences have showed this has not been the case. The firms are only to a limited extent using LCA as a tool (Broberg et. al, 1998). The demand for eco-labelled products is rather limited – with some organic food products as the exception that proves the rule. Furthermore, an investigation of 500 Danish companies indicated that the market driven pull in industry today is far from sufficient to respond to the environmental problems (Madsen & Ulhøi, 2001).

Since the late 1990's and up till now the product oriented policy has had a comprehensive perspective with more attention to actors and the market, e.g. by introducing product panels involving key stakeholders in a trade with the aim to kick-start the development and marketing of cleaner products. This policy has among other themes resulted in projects with focus on collaboration in the product chain.

The actors in the product chain

More actors have become involved in environmental management, as the focus has been extended from preventing environmental impacts of the production to innovation of cleaner products in a life cycle perspective. Besides management and employees in the production, also designers, product developers, purchasers, logistic, and marketing people become necessary in a product-oriented environmental effort (Remmen, 2000). The designers and product developers play an important role, as many environmental problems can be prevented already in the design and construction of the product. The role of the purchasers is to evaluate the environmental standard of the companies' suppliers and to be up-dated regarding more environmentally friendly materials and technologies. Development of cleaner products that never makes it to the market is a waste. Therefore, participation of the marketing and sales department is a precondition for diffusion of cleaner products (Remmen & Münster, 2003).

The importance of creating organisational conditions for synergy between the environmental function and other functions involved in the formulation of the business strategy has been stressed by Cramer & Schot (1993). With focus on innovation of cleaner products it can be questioned whether collaboration and synergy are enough. Such a comprehensive environmental perspective makes it necessary with an integration of the business and environmental strategy of the firm, where environmental issues are transformed to be an integrated way of doing business and involving all departments as well as product chain and network relations. However, as Cramer & Scot (1993) also point out innovation processes most seldom occur within the single company but between companies in an interplay. In the case of cleaner products, suppliers, customers and consumers have to be integrated in the traditional environmental network consisting of environmental authorities, business associations, auditors and management consultants (Remmen, 2000).

The flow of resources

The manufacturing, distribution, use, recycling and/or disposal of products are mainly seen as a flow of materials and services – a supply chain. One challenge is to change the open material flows to a close cycle with a high degree of reuse and recovery of old materials as resources in new products as well as reducing the amount and speed of exchange of materials between nature and society.

In the environmental debate attention has been given to the development of tools like LCA and to informative means like eco-labelling. The focus has been on the documentation of the environmental impacts of a product. However, in a life cycle perspective it is just as important to focus on the value flow related to the demands of consumers and how they consider the product (Remmen & Münster, 2003). So far the value chain had rather little attention in the environmental debate

and, consequently, there is also a lack of tools and investigations. For a specific company the challenge is to tight the product chain together in a way that creates synergy between the environmental optimisations of the material flow, and the expectations of the customers in regard to the money and value flow. One of the means to combine these flows in a comprehensive way is environmental communication and co-operation in the product chain (Remmen & Münster, 2003).

Communication and collaboration

The exchange, documentation and co-ordination of activities in the product chain constitute communication and collaboration and these processes can be viewed in a learning perspective. The differences between information, communication and collaboration can be seen as cumulative levels of learning. As Håkansson (1986) puts it, the dynamics of interaction are shown by the fact that it can be perceived as a learning process.

In the context of cleaner production Vickers & Cordey-Hayes (1999) see organisational learning as the process of organisational awareness recognising the potential benefits of information inputs by associating it with organisational needs and capabilities. The relevant information is afterwards communicated and assimilated within the organisation and applied for competitive advantage. Four types of learning can be distinguished (Vickers & Cordey-Hayes, 1999):

Learning by doing in manufacturing as a result of optimisation of the production process.

Learning by interaction as a result of contacts between supplier and contractor, or other external sources of knowledge and expertise.

Learning by using as a result of feedback from users.

Learning by learning where organisations develop the ability to be reflexive, such that institutionalised monitoring becomes an embedded characteristic.

The understanding that “doing” is only taking place in production, and “interaction” only in the relations to external stakeholder, etc. is quite simple. Doing, using, interaction and reflections on learning are taking place in all phases of the product chain as well as in the relations and linkages among the different stakeholders. This understanding of learning corresponds to the framework for organisational learning set up by Nancy Dixon (1999). The organisational learning process is similarly defined by four steps: collection and distribution of information, integration of this in a specific organisational context, collective interpretation of the information by the organisational members and actions taken on this basis. Experiences from the actions taken by the organisational members are compared to new information inputs and the process of organisational learning begins once again.

This understanding of organisational learning especially focuses on integration of information, but as pointed out this is a too narrow understanding of the dynamics in the product chain. Information is one-way e.g. transmitting environmental data from one company to another. Communication is learning by interaction, e.g. collaborating with the end-users in a product-development process. Using the notion of communities of practice Wenger (1998) emphasises inter-

organisational communication. A community of practice has a common interest and engagement in solving a specific problem that brings members together - and this might also imply a relationship across organisational limits. Thereby, communication becomes a matter in both organisational and inter-organisational relations.

The inter-organisational relations

Cramer & Schot (1993) talk about environmental co-maker-ship consisting of two steps, where the first step is exchange of environmental information between firms, and the second is placing environmental demands on suppliers by firms. In many cases, more environmental pressure is exercised by customers on their suppliers (that is, upstream) than by suppliers on their customers (that is, downstream), as customers often hold the balance of power in a customer – supplier relationship (Hill, 1996). One important impetus for customers to exert environmental pressure on their suppliers is legislative pressure (Hill, 1996). In the matter of the inter-organisational relations of *power/dependence* it is clear that the customers demand for cleaner products plays an important role, and in that relation trust and a common "language" in the product chain are important for the exchange of sometimes sensible information and experience.

However, Cramer (1996) uses the concept of Integrated Chain Management, which opens up for a higher agency at the supply side. Producers can have a significant role in changing the perceptions on the market, e.g. through intensive marketing of cleaner products. This can be initiated by unfulfilled expectations from downstream in the product chain, giving the producer a potential competitive advantage. Also differences in the environmental knowledge throughout the product chain can influence the power/dependence relations when it comes to co-ordinating environmental innovations.

For some companies informal relations will be adequate to exchange information on an ad hoc basis. For other companies a formalised co-operation or partnership will be necessary to secure co-ordination and commitment in the product-oriented environmental activities. Such a formalisation can be practised by creating an inter-organisational working group taking responsibility for co-ordination of the environmental activities, knowledge sharing, and exchange of experiences and information (Remmen & Münster, 2003). If the companies create such *closeness* /proximity in the inter-organisational relations, they facilitate a community of practice, where existing values and norms can be questioned and a common ground for environmental practice can be created. One of the pre-conditions for creating such a relation is building up mutual trust by meeting other *expectations* through commitment. Such an engagement involves a mutual problem solving under considerations of the specific organisational interests. As Håkansson (1986) points out, all inter-organisational relations have elements of both mutual and conflicting interest and their relative importance depends on how the companies view each other. Two different kinds of expectations can be distinguished depending on whether these are directed towards the content or the form of collaboration (Holgaard, 2003). Expectations to the content are increased if the members perceive the former exchanged environmental knowledge as relevant and competent. Whereas expectations towards the form of the collaboration are strengthened, if the members act in accordance with the culture and structure of the community e.g. the created norms and values, the used methods and the formal decisions made in the community of practice. But also due to different perceptions of future outcomes, actors will act in certain ways (Gadde & Håkansson, 1992).

Innovation and network activities in the organic dairies

One of the cases in the investigation of cleaner products in the POET-project was the product chain of organic milk, with an empirical, in-depth investigation of seven organic dairies, of which three of them also have a considerable conventional production. One company has around 14.000 employees; but otherwise the dairies are small companies with 10-50 employees. In the following section, the case studies will be described in line with the conceptual framework outlined in the previous sections. Where nothing else is noted the description is based on Ingemann et al (2000) and Thrane et al (2000).

The institutional set-up

In 1987 the Danish Parliament passed an act on organic farming, and among other things introduced a label for organic food products in 1990. The red Ø label guarantees that the production is organic and is monitored by state inspectors. This label has created the foundation for the increase in the production and sale of organic food products. The criteria for the ECO-label are focused on the impact from the primary production, which is the organic farming, whereas the regulation only vaguely addresses other phases in the product's lifecycle. For example the ECO-label does not cover environmental impacts from the production at the dairies or the amount of transportation used in delivering the product down-stream the chain.

The regulatory network has been important in promoting organic farming trough the organic label and the inspection. However, this initiative was strongly influenced by the pioneers in organic farming and their association (LØJ – Landsforeningen for økologisk Jordbrug) setting criteria to organic production that was nearly the same in the final Act on Organic Farming in 1987. An important explanation for the market boom from 1993 was that the main supermarket chain – FDB/ COOP – changed their pricing policy so the difference between traditional and organic milk narrowed down.

The market is characterised by a low export/import rate and a market structure with one large company and a handful of small organic dairies trying to stay in business by competing on organic products. The large company is dominating the market by having its own distribution system, a high degree of power in the business association, the resources to make an intensive marketing of its products and the size to make different types of products. The co-operation and exchange of knowledge between the dairies is limited, and some of the small firms are not connected to any organisation in the trade. Also the relation to research institutions is quite limited for the small dairies, however, some of them are occasionally using consultants.

The actors in the product chain

Up-stream the chain, the organic farmers are closely related to the dairies, as most of the dairies are cooperatives and have some of their suppliers in the board of directors. Downstream the chain, the retailers have played an important role in increasing the market share of organic food. In 1993 the market for organic food products changed drastically in a relatively short period of time, due to an intensive marketing campaign and a different pric policy among the retailers. In

the beginning, these initiatives mainly came from the Danish retailer chain FDB (Forenede Danske Brugsforeninger – the COOP), which invested 1 million Danish Kr. in an information campaign stimulating sales of organic food, but later the same pricing policy spread to other retailers due to the interest from the consumers.

The consumers' understanding of quality is the key to a higher market share for organic milk.
The consumers are gradually moving towards a broader perception of food quality. Some consumers go beyond focusing on traditional product parameters as taste, convenience and food safety, and are also considering the production methods to some extent including ethical, social and environmental concerns (Nielsen & Kristensen, 1996). In this way quality is changing to an immaterial sphere and product quality can no longer only be sensed by smelling, tasting or looking. The "hidden" quality has to be communicated to the consumers.

The investigation of the organic dairies resulted in a distinction of three different profiles among these seven dairies:

The first type was primarily driven by an economic rationality, where the organic dimension tended to be a mean more than a goal in itself. The product and process innovations related to organic milk were limited.

The second type was motivated by an economic rationality but an ecological understanding was also present. The product and process innovations were prioritised as a way of differentiating on the market for organic products.

The third type was driven by a strong ecological attitude closely related to their private "way of living". The product and process innovations were prioritised, but also social concerns had a high priority in their way of "doing business", e.g. making initiatives to engage people in urban areas.

In general, the ecological understanding was related to the primary production and informally integrated in the organisational culture in the small dairies (only one had an environmental policy). The large firm was more focussed on organising and documenting a systematic environmental effort.

The traditional flows

The flow down-stream the chain is beginning at the organic farm, continuing to manufacturing at the dairies. The dairies also take care of the marketing and distribution to the retailers. The retailers sell the product to consumers, who use it in the households and afterwards put the packaging material in the waste. This flow is shown in figure 3.

At the organic farm two primary types of production take place: cultivation of plants and animal production. The output from cultivation of plants is vegetables, fruit and corn for sale or feed for animals, e.g. beets, clover and green fodder. In the animal production a part is for meat-production and the other part is for producing secondary products as milk and eggs. For organic milk with the Danish State controlled ECO-label, the production of fodder has to be organic. Furthermore, the milk must not be homogenised, that is the particles of fat are to keep their normal

structure (Økologisk landscenter, 1998). After manufacturing the organic milk is distributed to the retailers. A small amount of organic milk is sold directly from the farms or the dairies. The consumption of the milk is then taking place in private households, industries and public institutions.

From the mid 1990's there was a considerable increase in the market for organic products indicating a change in the preferences of the consumers. For example, the number of organic farms in Denmark increased by a factor eight, the square metres of organicly cultivated land increased by a factor 150 and the organic milk production increased by a factor 20. This was due to initiatives of the state, the organic farmers and the retailers. Furthermore, conventional farmers and food industries have integrated organic methods into part of their production, and this tendency has been most prominent in the dairy sector (Ministeriet for Fødevarer, Landbrug og Fiskeri, 1999). At a certain point in the mid 90's, which was said to be the first time in the history of Danish agriculture, the organic farmers and dairies could not meet the market demand from the consumers.

To some extent this has increased the focus on product innovation and the need "to have an ear on the market" in the food industries. Today the picture is to some extent the opposite: The production of organic food is higher than the demand, and for that reason the organic farmers are paid a lower price from the dairies.

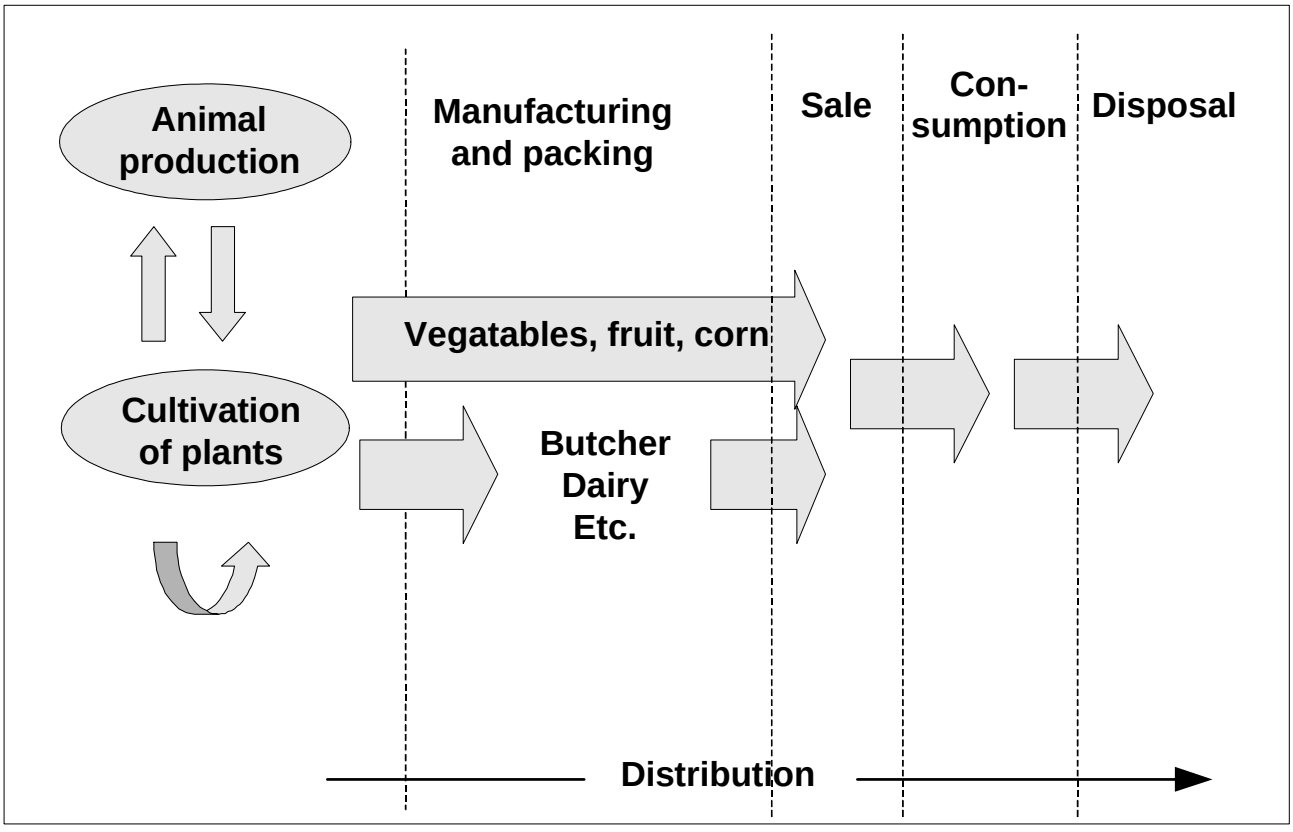

Figure 3: The traditional flow downstream in relation to agriculture products.

Communication and collaboration

The small dairies are nearly all cooperatives, and this means a strong tradition for partnership and very close communication and collaboration between the organic farmers and the dairies. The managers of the minor dairies described the relation to the farmers as positive regarding knowledge exchange and periodic meetings in the board. A manager of one dairy also had private relations to some suppliers, which strengthened the trust and mutual collaboration. Besides, the close collaboration between primary and secondary producers is followed up by monitoring and control systems to secure the quality of the milk, e.g. by reflecting quality in the price paid for the milk.

With regard to the suppliers of machinery and cleaning, the managers of the dairies had a positive collaboration and exchange of knowledge with them, but environmental issues were seldom on the agenda. This also seemed to be the case in the collaboration with the retailers, which was oriented towards the traditional flows in the business network. The knowledge exchange was mainly in connection to unexpected problems, and often the concern was traditional quality features and the position to deliver. The retailers do not have a tradition to serve as a link of information and knowledge exchange from the consumers to the producers.

Close contact to the consumers was stressed as an important source of information, e.g. through market investigations, feedback from the consumers by email or by demonstrations of the product in the stores. Here, the organic farmers took part in presenting their own product, and at the same time in giving the history of the products to create a proximity between the primary producers and consumers. Only the large dairy had an intensive marketing of organic products, trying to affect the attitudes of the consumers via commercials in television and newspapers.

An overall evaluation of the communication and collaboration in the chain of organic products showed that the weak links in environmental communication were related to the retailers. Only one chain of retailers showed interest in an environmental dialogue within the product chain and in preparing information to the customers, which went beyond ECO-labels. Learning by interaction in inter-organisational communities of practice was only present in the co-operation between the primary and secondary producers, besides initiatives to demonstrate the ecological products to consumers.

The inter-organisational relations

The knowledge of organic milk is most often concentrated in the primary production. In cases where organic farmers have a role in the board of the dairies their knowledge was also reflected in the secondary production. However, the focus on primary production seem to have an important role in defining quality, as working conditions and environmental impact from the production and distribution are not a main concern. One of the reasons is perhaps that small diaries do not need an environmental approval from the authorities.
Many consumers are lacking information to value the criteria for organic products, and therefore demand for specific features of quality is not common. The choice of buying an organic product is related to sporadic information given in the media and a matter of life-style – and in both cases it is a question of trust to the actors in the product chain. The prices of organic products are higher than of traditional products and therefore the arguments for buying organic products have to be

much more rooted in the consumers' perception of quality and health. A trend is that the organic producers try to compensate for the "missing link" of information from the retailers by putting a fair amount of information on the products. Today, it is quite common that an organic farmer tells the story about his/her farm and motivation to produce organic products. In some cases a picture from the farm is shown in order to create a feeling of proximity to the primary producers.

Closeness and trust seem to be an important part of the inter-organisational relation among the minor diaries, and for some it is a decisive condition for their presence on the market. For example one dairy has only one customer, and a good relation to that customer is therefore essential. However, even though many minor dairies complain about the conditions on a market dominated by one large company, there have not been initiatives towards stronger collaboration between the minor dairies. One reason is that they are afraid of being caught in the middle – being too big to have proximity to their suppliers and consumers, but too small to compete with the large company dominating the market.

The types of innovation activities

A new institutional set-up has been created to regulate organic food products, and therefore Ø-labelled products can be seen as a radical innovation. At least it has resulted in different types of marketing and financing, different types of input and a different pattern of productivity gain. The value-flow from the customers has changed to consider the hidden quality of the products including the willingness and the information to choose an organic product even if the price is higher. However, this green consumerism did stagnate in the end of the 1990's, and still most consumers are buying traditional products at low prices.

Even though there has been a considerable change in the market institutions of dairy products, the changes in the production processes at the dairies are quite limited. Because of the small scale of production it is likely that the environmental impacts are higher from the production process in organic dairies compared to conventional. This is partly due to the emphasis on the primary production in the regulation and labelling of organic dairy products. Furthermore, the lack of resources to invest in environmental innovations and the small administrations in the minor dairies make barriers to a systematic environmental effort with continuous environmental improvements.

However, some of the minor organic dairies are trying to differentiate themselves on the market by making incremental process or product innovations. To reduce the environmental impact from the production, the emphasis has been on improving the working environment and reducing the use of resources. But only few of the minor dairies are working with this in a systematic way, except from one dairy having an ISO 14000 certification like the large dairy. The innovation of organic dairy products has been at the incremental level, transforming traditional products to organic and at the same time improving the quality of the products. In that way traditional products have been supplemented by organic alternatives in other types of dairy products, e.g. cheese and butter. Especially, Thise Dairy has used the knowledge that milk from different kinds of cows has different qualities and therefore has to be used to different purposes like cheese, butter, etc. Only, one example of a more radical product innovation was found in one of the minor dairies using goat milk for the production of ecologically sound products.

Innovation and network activities within the fish processing industry

The empirical investigation of the product chain of fish products in the POET-project consisted of in-depth case studies of ten fish processing industries. Three companies have less than 50 employees, four less than 200, and three have more than 200 employees. In the following we will describe these studies in line with the conceptual framework applied in the last section. The description is based on Thrane (2000a & 2000b), if nothing else is noted.

The institutional set-up

The regulation of the Danish fish sector can only be understood in relation to EU-policy on resource conservation, modernisation of technology and market conditions. The means to regulate the fish stock have mainly been normative by setting quotas for the catch of different kinds of fish and economic support to renewal of the vessels. The regulation is highly focused on primary production. The EU regulation has been criticised for its complexity, its limitation in reducing the number and capacity of the vessels and a lack of consideration regarding sustainability issues.

In a Danish context it has been considered to label fish products in order to give the consumers a possibility to choose an ECO-friendly fish product. However, this process has stranded in discussions on criteria. The business associations in the sector have been reluctant, as they consider the environmental impacts from fishing as insignificant compared to other environmental impacts on the ocean. Furthermore, they fear that “non-labelled” products will be met with suspicion by the consumers.

In general the fish sector in Denmark is characterised by relatively few and old organisations. The focus on environmental issues is limited and emphasis is on having influence on future regulations. However, in the 1990’s a couple of organisations were founded with a specific focus on promoting more sustainable fishery and a cleaner ocean. Landsforeningen Levende Hav (The Danish Society for A Living Sea) and Fiskernes Økologiske Netværk (The Fishermens’ Ecological Network – www.ecofishery.com) are two significant non-governmental organisations. Only few knowledge institutions related to the sector are dealing with the environmental impacts and development of cleaner products. The notion of sustainability is not new in the fish sector, apart from aspects of resource exploitation.

The market for fish products is characterised by a high export rate – most of the fish landed in Denmark is exported, approx. 95 %, and 80% of it to countries within the European Union. The Danish fish sector is under pressure from different kinds of competition. Firstly, the international competition has increased due to the opening of the market and due to more imported semi-manufactured products. Also products like chicken and turkey are increasingly being competitive to fish products. Secondly, a centralisation among the retailers has taken place and their possibility to put pressure on the primary and secondary producers to lower prices has increased. Thirdly, the amount of fish resources is decreasing, causing the regulatory authorities to set up fish quotas. Finally, the Danish fleet of fishing boats is relatively old, and therefore investments will be needed within a limited period of time.

The actors in the product chain

There is no tradition for cleaner technology in the primary production, e.g. developing new fishing methods. Seen from the perspective of the fish processing industry, the fishermen are emphasising the amount and quotas for the different fish stocks and neglecting the environmental dimensions. The fish processing industry have made some demands to the fishermen regarding quality, but it is difficult to motivate the fishermen to begin a dialogue, as they have no problems in selling the legal amount of fish.

Instead, the initiative to environmental activities has come from fish processing industries, and more than half of the companies visited had an environmental effort beyond compliance. Four of the companies had a certified/registered environmental management system and three of the companies had some experience with life cycle assessment. However, the understanding of environmental problems and solutions was closely related to the companies' production process. A few companies have potential for increasing the environmental co-ordination up-stream in the product chain, as they also own the vessels.

As in the case of organic agriculture products, some of the retailers have taken initiatives towards promoting fish products of higher quality, also considering environmental concerns in the fish processing industry. Retailers as Marks and Spencers and Unilever are rating the companies' environmental performance via environmental audits. The German and Austrian purchasers have been concerned with environmental impacts related to the packaging materials. Danish retailers are also showing an interest in the quality of products. Several firms point to FDB as a frontrunner in the case of agricultural products. The manager for environment and quality in FDB thinks that the consumers will be positive towards ECO-labelled fish products, but they have to be informed about the criteria for the label.

In general, there has been increasing awareness among the consumers about environmental impacts related to the products, indicating a potential market for "ecological" fish products. In an analysis of 65 Danish and German retailers, based on interviews with purchasers of fish and pig products, it was concluded that the importance of the price was decreasing due to changes in consumer attitudes. Thereby the 4Ps (price, product, place and promotion) may not be sufficient to stay in business. Trust, liability and creation of long-term relationships are becoming more important in the future business to business relations (MAPP, 2000), even though the price-aspect is still important for many consumers.

The traditional flows

The product chain from sea to table includes activities in fishing, auctioning, manufacturing, distribution, trade and use of the products. The disposal is mainly connected with packaging materials. A simple picture of the flow of materials downstream the chain is shown in figure 4. This picture is more complex when it comes to information, e.g. there is a low possibility of following a particular fish from sea to table, and information regarding traceability is lost, besides what can be seen, felt or tasted. Most fish are caught by the use of trawl, which is an energy consuming type of fishing. Depending on the fishing method and way of treatment there will be a certain by-catch and discharge of fish and other animals/plants. Also in aqua-culture there is a waste of resources, mainly

due to the use of fodder. Fish from sea is typically landed close to or transported to the fish processing industry and a decreasing amount of fish is sold on auctions. Mackerel and herrings are sent directly to manufacturing, and the same is the case for fish used for production of fishmeal and fish oil.

The next link in the chain is the fish processing industry, where one part is semi-manufactured and exported, while another part is manufactured to finished goods. After that the fish is distributed to the retailers, eventually through a wholesale dealer. The transportation means are important in relation to the quality of the fish, but also related to the environmental impacts in a life cycle perspective. After that the fresh fish or the fish products are sold in supermarkets, specialised shops, and to professional kitchens like restaurants, hospitals, etc. During the use phase there is some environmental impact in relation to the storage and preparation of the fish, e.g. due to energy consumption, discharge of wastewater and disposal.

Several companies have noticed a higher emphasis on environmental concerns. Even though there is a market for high quality fish products, the companies stress that the price is still the most important competition factor on the Danish market and likewise for Eastern European markets. In other words, a dual trend is noticed with both a discount-market and a high quality market. In total, the money-flow has increased from 1993 to 1998, where the economic value of the fish landed in Danish harbours increased from 3.12 to 4.23 billion Danish Kr. (landings from national vessels were about 80%).

Communication and collaboration

Closer and more long-term relations between the primary and secondary producers are a pronounced tendency, and mainly with quality in the traditional understanding on the agenda. One fish processing company has an environmental management system according to EMAS (EU's Environmental Management and Audit Scheme), and has tried to set environmental demands to their suppliers. However, in general the fishermen are perceived as reluctant and hard to convince to an environmental effort.

The collaboration with other suppliers, e.g. of machinery is positive in the case of knowledge exchange, often resulting in cleaner technology and a better quality of the product. In relation to suppliers of semi-manufactured products, there has been knowledge exchange in order to prevent GMO and dioxin in the products. One of the companies was auditing some of the suppliers of salt and had prepared evaluation schemes in relation to their environmental performance. However, the companies' interest at this point is to evaluate whether the suppliers have a matching environmental attitude, more than it is an evaluation of environmental data (the amount of GMO and dioxin was an exception).

Collaboration is far from being a tradition in the fish processing industry, but the companies seated in the town of Skagen have had success with such collaboration. First of all, many companies have implemented environmental management systems and thereby they got a common reference for discussing environmental problems and solutions. According to the industry they now also see each other as colleagues and not only as competitors.

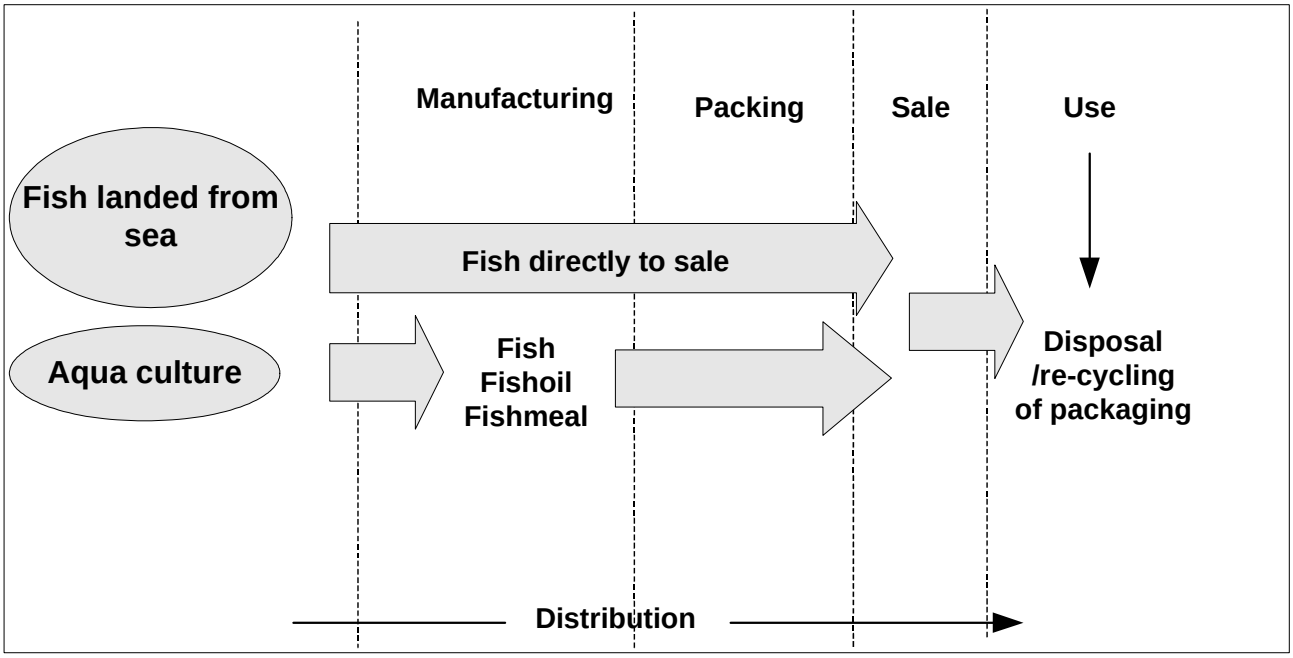

Figure 4: The traditional flow downstream related to fish provision.

Secondly, the collaboration is also on the operational level with co-ordinated strategies in several areas, e.g. introduction on new markets like China. The relation to customers on environmental issues is rather limited, and there has not been a pressure in this area, but there is general control of the performance of the manufacturers. There are a few examples, e.g. discussions to make the packaging material more environmentally friendly. Regarding product innovations in general, collaboration was seldom among the small and medium-sized companies. However, one large company collaborated with several retailers on arranging meetings and brainstorming on potential product improvements considering the market situation. The contacts to consumers were even more limited, and the marketing effort in relation to new product development is limited.

The inter-organisational relations

Most of the companies consider trust as a parameter with increasing importance, but they focus on a selected group of customers. One of the companies separates the customers into three types: dialogue customers, basic customers and secondary customers. With dialogue customers the company has a relation based on mutual interests and trust. The same tendency is seen among the retailers in the case of FDB in their collaboration with suppliers. The result of this strategy among the retailers can be that the suppliers have to consider social capital in business to business relations.

An understanding of fish-products as beneficial to your health has been dominating. In Denmark, the fish industry has tried to increase the consumption of fish through an intensive campaign. The campaign ran from 1996-1999 with a total cost of 110 million Danish Kr. and was financed by the European Union and the Danish government.
In a positive view, investigations showed that the campaign did increase the consumption of fish.

On the negative side this campaign has not motivated a differentiated understanding of the quality of fish products, and this can be a future barrier for introducing “ecological” fish products.

The power-dependency of the customers of the fish processing industry is also important as they compete on the international market. The European retailers have been centralised and this has strengthened their power-position on the market. The ten largest chains of retailers have about one third of the sale of food products in Western Europe (Fiskebranchen, 1999). Therefore, the strategy of the different retailers concerning organic products has a high importance.

The types of innovation activities

The overall impression of the fish industry was that the fish processing companies were innovative and creative in making process innovations. Especially, the small and medium-sized companies have made several environmental process innovations. The focus is on cleaner technology in order to reduce the use of energy, water and raw materials. As mentioned, half of the companies have a certified/registered environmental management system and three companies have some experience with life cycle assessment.

The results from this effort have been considerable. Nielsen (2000) has analysed the reduction of organic material and the reduction of water consumption from five Danish fish processing companies in the period from 1989 to 1997. These companies have reduced the kg COD per ton raw material with up to 80% and the m^3 of water per ton raw material with up to 50%. Actually, in some companies the process innovations have been so radical, that the possibility of reducing resource consumption any further is considered to be limited, because this will then influence the product quality.

The tradition of making process innovation is strong, but this is not the case for product innovations – also in comparison with the dairy industry analysed in the previous section. In the small and medium-sized companies many changes in the product were caused as an effect of process innovations. However, these spin-offs are mainly incremental changes, e.g. de-skinning of herrings. Most companies investigated are sub-suppliers to other companies, and this is a considerable barrier for product innovations, as the fish processing companies do not want to compete with their customers. This power dependency is an important explanation in order to understand why the producers hesitate to make product innovations.

Concluding remarks

In this paper we have analysed organic milk and fish products by using a comprehensive framework for collaboration in the product chain, constituted by the following elements:
The institutional set-up of the product chain is constituted by the regulative, knowledge and market institutions.

The actors in the product chain are seen as a network of interested parties, who at one point in the product chain has responsibility for the product. The traditional flows including the flow of re-

sources (material and service) downstream the product chain and a value and money flow upstream the chain.

Communication and collaboration is interactive – "running" upstream and downstream, exchanging, documenting and co-ordinating the activities in the product chain.

The inter-organisational relations are constituted of power/dependence, co-operation, closeness and expectations.

The collaboration in the product chain has been seen in close relation to the environmental innovations in the two product chains, whereas the *type of innovation activity* in the two industries also has been a part of the investigation.

In the product chain of organic milk there has been a huge effort in order to develop and diffuse organic milk products; especially concentrated among the primary producers. The environmental focus has been product oriented, and environmental process innovations were neglected in small and medium sized dairies. However, the institutional collaboration between NGO's, retailers and state institutions has been strong, resulting in the possibility to label organic products. In the product chain, organic farmers with a deeply rooted ecological understanding have been the drivers behind these institutional changes - with important support from the retailers, especially COOP Denmark in the beginning. However, only one chain of retailers showed interest in an environmental dialogue within this product chain and in preparing information to the customers beyond the organic label.

In the fish industry the environmental effort was mainly carried by initiatives in the fish processing companies, motivated by regulation and requests from the international market. The ecological focus was process oriented, focusing on good environmental housekeeping in manufacturing of the products. The institutional set-up for environmental considerations in a product oriented perspective is vague, e.g. only few criteria are available for marketing of fish products, and so far it has not been possible to reach consensus regarding a set of criteria for eco-friendly fish products. Reluctance from the fishermen and a lack of communication between environmental organisations, sector organisations, authorities, retailers and customers seem to be the strongest barrier for promoting a more sustainable fish industry. However, the investigation also shows that the fish industry is interested in continuing the environmental effort further in the product chain.

In order to promote a development towards more sustainable food products it is important to consider the differences in the collaboration and innovation activities in the different product chains of the food industry. Taking the product chain of dairy and fish products as an example there are some main differences concerning:

Who in the product chain has the environmental initiative: For the dairy industry the initiative was taken in the primary production, whereas the secondary production has been the driving actors in the fish industry. In both sectors some retailers have supported these initiatives.

The type of innovation activity: In the dairy industry focus has been on incremental product innovations, and the production of organic products is closely related to the conventional production.

In the fish industry product innovations are very limited, but there is considerable process innovations using cleaner technology to reduce the consumption of resources.

The possibility to market more sustainable products: In the dairy industry an important driver has been the possibility of getting a state-controlled organic label on the products, while in the fish industry a similar initiative has ended up in discussions.

In the long run the development in the sector of food products is expected to change from upstream dominance to downstream dominance. This has been the case with organic milk – at least in a period of time – with the consumers as important drivers. But even though the consumption of food products is affecting the health of the consumers, the price is still a considerable and often overshadowing parameter in the marketing of food products.

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Process and product-oriented environmental policy within the car chain

By Carla K. Smink, Eskild Holm Nielsen & Tine Herreborg Jørgensen

Abstract

The phases in the life cycle of a car can be considered as a chain. These phases include: raw materials extraction and processing, manufacturing, use, and dismantling. Public environmental regulation covers all actors within the car chain. Often, such regulation is aimed only at a single phase. This article focuses on end-of-life vehicle regulations and product chain management. In the first part, we consider these aspects in theory. Thereafter the focus shifts to the car industry in South Africa (i.e. BMW, Delta Motors). Initially, the environmental policy of 'parent' companies (i.e. BMW and GM) will be analysed. Thence, the extent to which these policies affect the strategies and actions of their South African assembly plants is investigated.

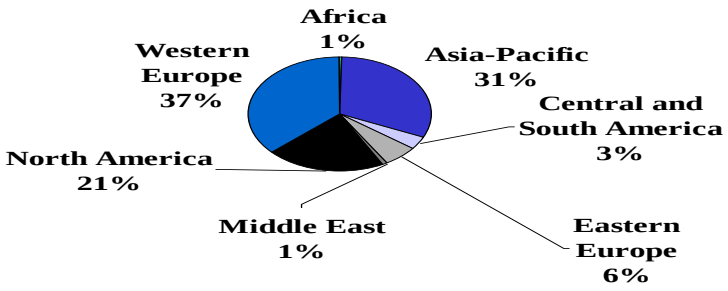
Key words: car industry, end-of-life vehicle regulations, product chain management, and environmental strategy.

Introduction

The auto industry is the largest manufacturing industry in the world. It is also one of the most resource-intensive of all major industrial systems (Mildenberger & Khare, 2000). With a turnover of more than a trillion dollars, it employs about ten million people (West, 2000).

Environmental impacts related to the total life cycle of a car are pronounced. Many environmentalists suggest that, through its lifetime, the car is the most polluting product on earth (Gouldson, 1993). World-wide, increasing population and mobility is expected, and one result is likely to be increased pollution from cars in the future.

The lifetime for the average car in a typical industrialised country is 10-12 years. That is, it takes the average car 10-12 years to go from vehicle assembly to dismantling, recycling and landfill. The raw materials extraction and processing phase adds one year to this. In addition, car manufacturers typically require 3 to 5 years in order to develop new models, which may then remain in production for anything between 4 and 15 years. Thus, any initiatives implemented in vehicle designs will carry environmental implications for at least the next 20 years (Nieuwenhuis & Wells, 1997). For convenience, the environmental impacts from cars can be divided into those arising from production and those due to use.



Africa	Asia-Pacific	Central and south America	Eastern Europe	Middle East	North America	Western Europe
253.494	12.318.040	1.379.300	2.465.300	392.000	8.261.100	14.615.230

Figure 1: World-wide annual car production 1999 (Autointell, 2001).

In this article, the production phase will be considered as including the extraction and processing of raw materials, as well as manufacturing and dismantling. Our primary focus will be the environmental regulation of car production. In addition, we will look at the impact of regulation.

We will analyse the environmental activities – in response to regulation - of two car producers, namely BMW and General Motors (GM), taking Opel as an example. Empirically, the points of departure are the assembly of BMW and GM cars in South Africa. We will analyse, how environmental activities at these production sites are related to the environmental strategies of the parent companies within the whole product chain. For decades, different legal instruments have been used in order to regulate car production. Moreover, car producers have sought to address the demands of 'green' consumers. Such consumer demands are supported by the product orientation of environmental policies. Environmental regulation of cars will be described later. Both BMW and Ford have adopted a policy of applying "Best Available Technology" (BAT) in all production units. This reflects not only a response to environmental regulation but - probably - also an awareness that BAT potentially improves competitiveness. Car producers have established environmental co-operation in the product chain (figure 2), which includes: the flow of materials from cradle to grave; a flow of value and cash from consumer to car producer; and finally communication and co-operation as mutual exchange of knowledge and experiences.

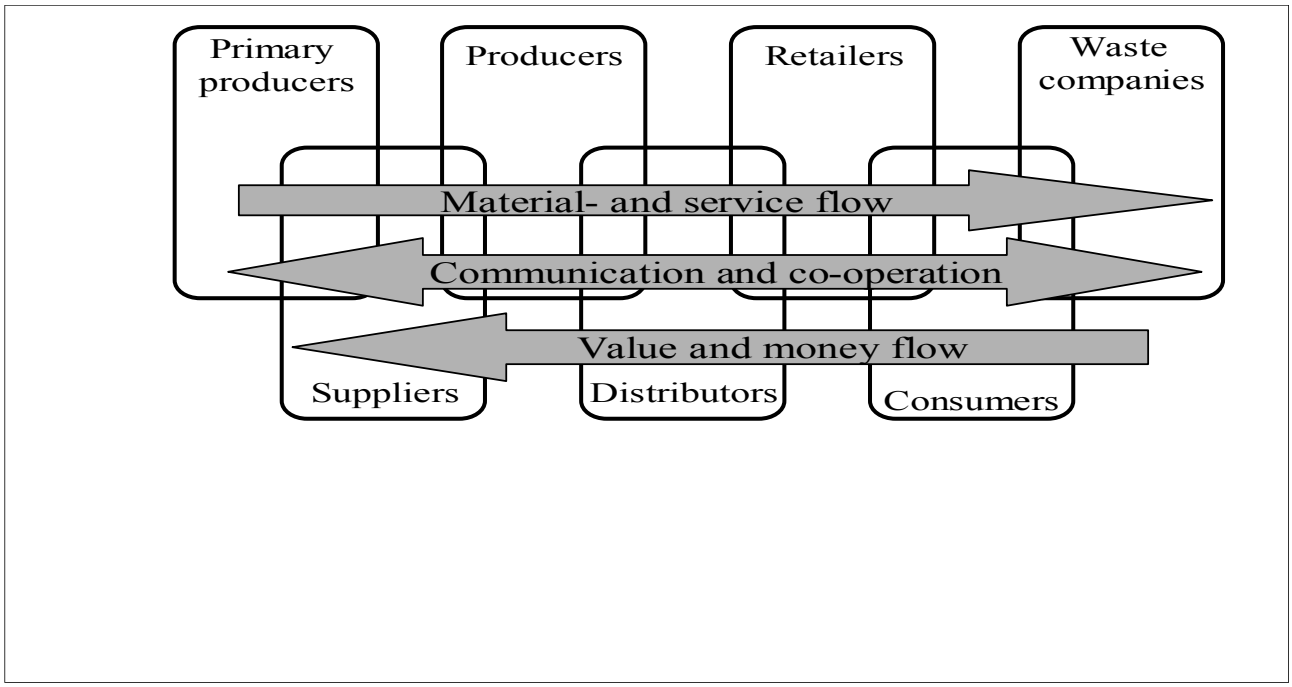


Figure 2: Co-operation and communication in the product chain (Remmen et al.).

In order not to make the figure too complicated, emissions and waste from each of the phases in the product chain are omitted. To an extent, cash and value flow as well as communication and collaboration in the product chain will determine the technology used in different phases. Thence, the technology used will serve to determine the material and service flow in the product chain. Figure 2 is one way of describing environmental activities within the product chain. It has served as a point of departure for our empirical studies in terms of investigating the environmental communication and the co-operation in the car chain. Figure 2 represents only one perspective on the product chain, however.

We have chosen to augment this with a network perspective (see figure 3). Although the approach to co-operation is more general, the network perspective shows the car chain in more detail, allowing for expression of the complexity of the product chain and its network.

'Car manufacturers' in figure 3 consist of both parent companies and assembly companies. The car chain consists of two, more or less independent, networks: production (including the raw materials extraction and processing phase and the manufacturing phase) and the use, recycling and disposal network (in-use, recycling and dismantling phases). Contacts between actors in the two networks are limited. According to den Hond and Groenewegen (1993: 351), the reason why this link has been weak is that car manufacturers have had no specific interest in connecting with dismantling companies and breakers. In fact, they may even have tried to avoid association with dismantling activities, which are dispersed, sometimes semi-legal or illegal, and often directly competitive with dealers for the spare-parts market.

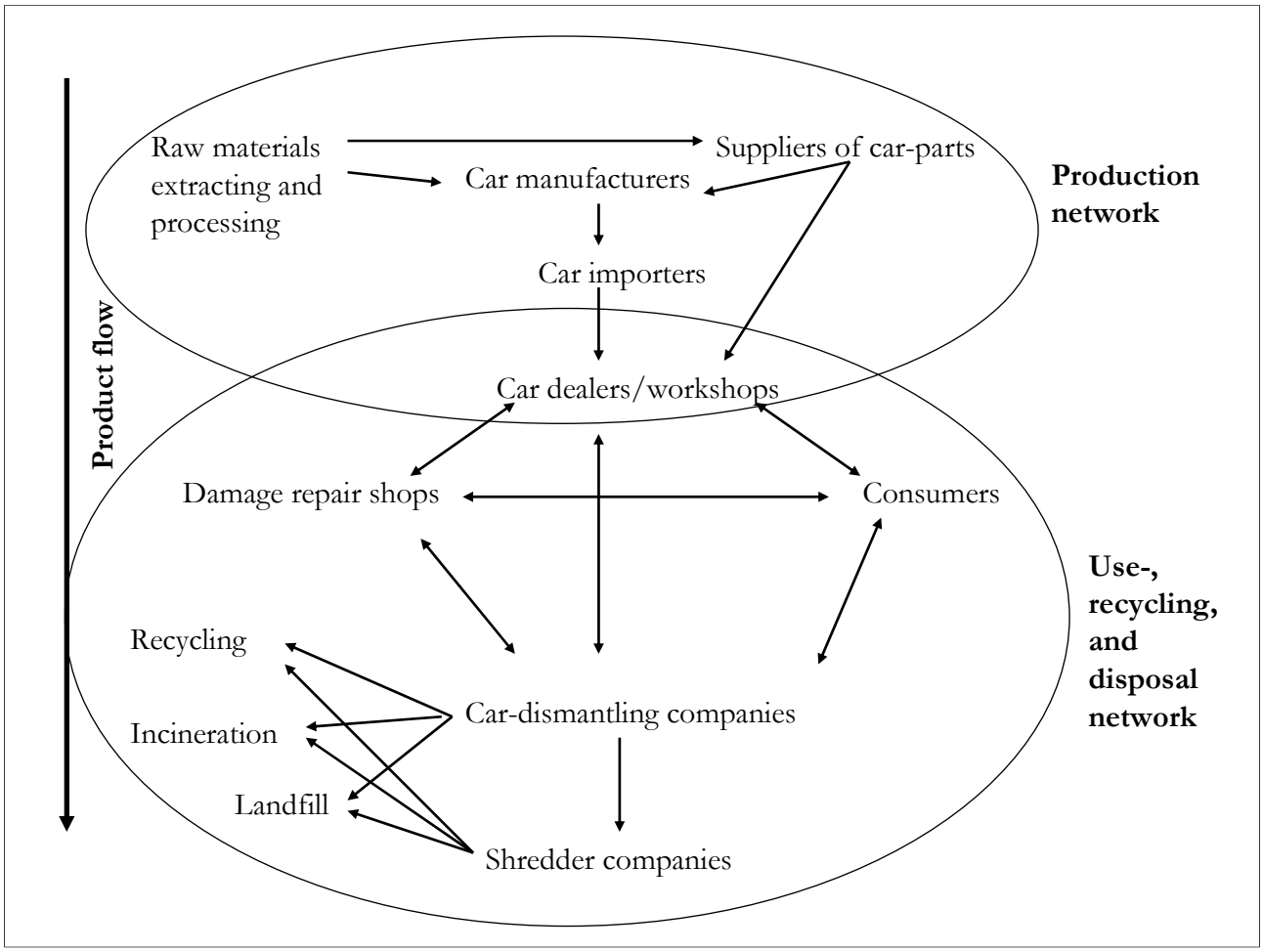


Figure 3: The car chain and its two sub-networks (Smink, 2002: 163).

A statement from a Ford Motor Company dealer is illustrative of a certain attitude: 'We do not want to collect old Ford vehicles via our dealer network. People, who are planning to buy a new car, do not wan to see a mound of end-of-life vehicles at the car dealer' (Interview Ford, 2001). Relations between actors in the car chain can, then, be considered weak. Interactions are incidental, focused on specific activities, or informal, based on personal relations. Co-operation and communication between the two networks hardly exists. This may well develop, however, in response to the implementation of product-oriented environmental policies.

Environmental policies and regulation

Almost all actors and environmental effects in the car-chain are subject to public environmental regulation. So far, regulation have been fragmented and not integrated. As command and control regulation (see Table 1), efforts have concentrated only on one phase of the car's life cycle.

Raw materials extracting and processing	Manufacturing	Use	Dismantling
IPPC- permit; EMS. Depletion quotas on extraction and import of virgin materials; Taxes on the use of virgin materials; Recycled materials quotas; Manufacturer-supplier partnership; Extended product responsibility. Emission limit values based on BAT	Public environmental regulations; EMS; Extended product responsibility; Manufacturer-supplier partnership; Taxes on the use of virgin materials; Emission standards. Emission limit values based on BAT	Speed limits; Car care products; Extended service responsibility; Fuel price; Tax; Environmental standards service stations.	Public environmental regulations; EMS; Waste regulations; Voluntary agreements; Recycling quotas; Recycling partnerships; Recycling programmes.

Table 1: Examples of public environmental regulations in the life-cycle of a car.
(Adapted from Mildenberger & Khare, 2000).

For many years, command and control regulation was aimed mainly at emissions from material production, product manufacturing and disposal. Control has been by means of end-of-pipe solutions. End-of-pipe technologies (e.g. sewage and water cleaning systems, tall stacks and filter technology) were seen as the most efficient method of bringing about a clean up.

Rather than prevent pollution, however, end-of-pipe technologies often merely shift it. They specify the precise source from which emission reductions must come (media-specific approach). This approach will convert pollutants rather than reduce total quantities.

During the 1980s, a shift in the regulatory approach in many industrialised countries can be observed. This shift is away from media-specific approaches towards a focus on processes. In a process-oriented strategy, the emphasis is on individual companies in the product chain and how they can reduce their environmental impact. Moreover, environmental problems are increasingly regarded as resulting from an interaction of the steps and stages in the process rather than one specific action. Thus, attempts are made to reduce problems via an integrated approach. An example of a process-oriented strategy is the implementation of an Environmental Management System (EMS). To date, companies have mainly been regulated by standards. Environmental standards can, in principle, be divided into those that are performance-based and those that are technology based. Performance-based standards regulate the emissions of industry by demanding a specific target in terms of pollution per unit (e.g. milligrams/litre). The performance is normally based on national guidelines or an assessment of the local recipient. Technology-based standards are based on what is achievable when using Best Available Technology, which reflect the most efficient production technology and abatement technology available on the market. In practice, however, regulation is not based on either technology-based or performance-based standards but rather on both technology-based and performance-based standards.

During the 1990s, the process-oriented strategy was increasingly supplemented with a product-oriented strategy in a number of industrialised countries. Limitations of the process-oriented strat-

egy are that environmental efforts are limited to single companies. Sooner or later, therefore, the possibilities for environmental improvements will be exhausted. In section 3, this will be illustrated on the basis of the car industry in Europe (parent company) and South Africa (assembly plant). In a product-oriented strategy companies have to make demands on other companies in the product chain in order to improve their environmental performance.

Figure 4 illustrates the development from end-of-pipe solutions via a process-oriented strategy to a product-oriented strategy. As we will see in section 3, those parent companies within the car industry that are located in Europe have, to a certain extent, adopted a product-oriented strategy. Thus far, however, their assembly plants in South Africa have not been affected by that strategy. Over the last 10 years, regulation of industrial activities has become more preventive (Gouldson et al, 1998). In 1991, OECD recommended that member states introduce Integrated Pollution Prevention and Control (IPPC) into national regulation. IPPC is based on the principle of Best Available Technology. BAT is one of the core elements in the 1996 European Union (EU) Directive on IPPC, which covers many of the processes in the car production. In the EU, product orientation has been promoted via the IPP Green Paper, which represents one of the most integrated environmental policies on pollution from cars. In this article we will try to deal with some of the initiatives within regulation pertaining to the car sector. As already mentioned, the life of a car can be represented via the following phases: raw materials extraction and processing, manufacturing, use, and dismantling.

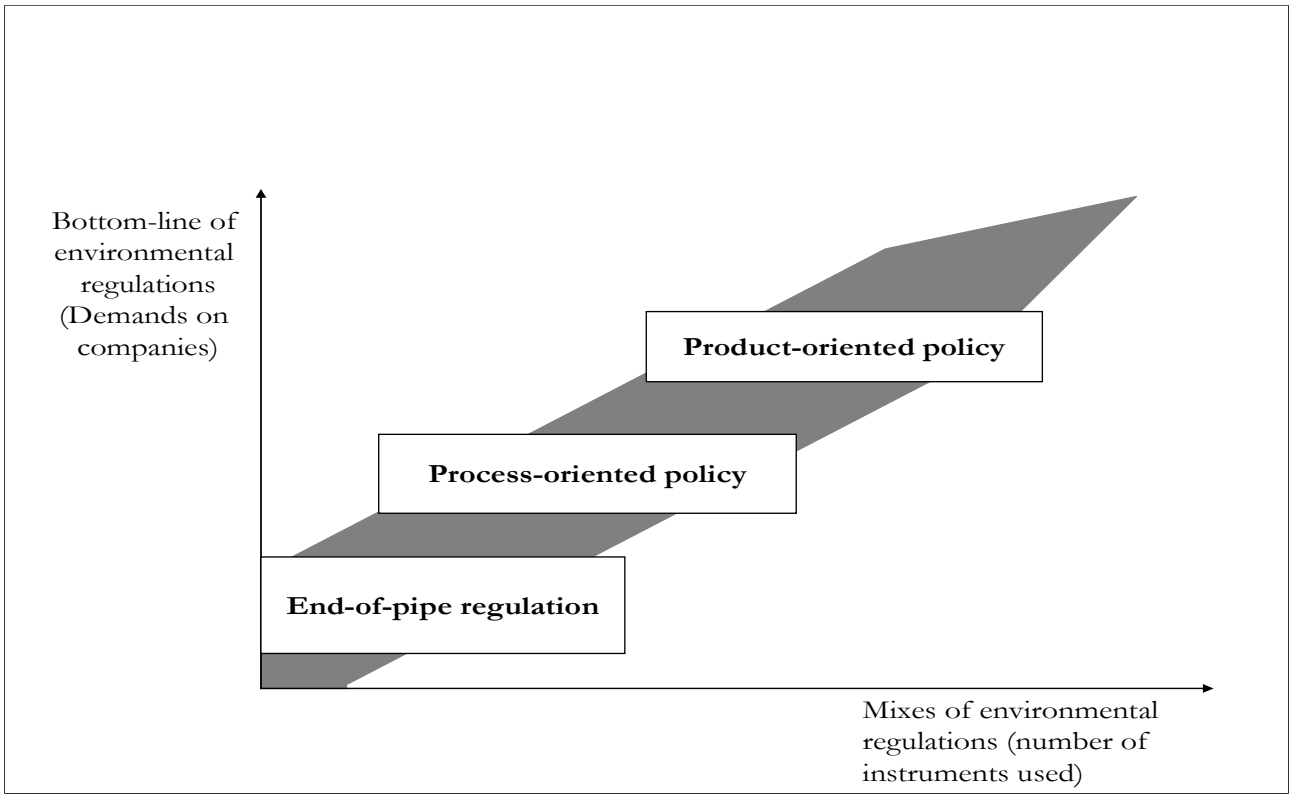


Figure 4: Bottom-line of environmental regulations (Smink, 2002: 247).

Table 1 gave an overview of different public environmental regulations in the car chain. In most cases, national public environmental regulation pertaining to phases in the car chain has global implications. When the EU implements regulations on the CO2-emissions of cars, for example, American and Japanese car manufacturers will have to meet the specified criteria if they want to access European markets. Because all car manufacturers, suppliers and car-dismantling companies have to comply, End-of-Life Vehicle (ELV) regulations will have a similar global impact.

ELV-regulation

In order to reduce the environmental impact of a car in the immediate term, much can be achieved by means of end-of-life regulations. Via the introduction of Directive2000/53/EC, the European Union (EU) has taken the lead in reducing the environmental impact of ELVs. An important role is allocated to car-dismantling companies. By 2015, the percentage of an ELV recycled has to be at 95%. This target cannot, however, be achieved by dismantling companies working in isolation. There is also the need for action by other actors in the car chain. Thus, in order to prevent waste from ELVs, important roles are allocated to carmakers, materials suppliers and equipment manufacturers. As explained in the introduction, however, it may take several years before changes in product design and materials use contribute to a 'greener' car, i.e. one that is less polluting in its entire life-cycle. This means that focus should increasingly be on supply chain management, whereby actors in the chain make demands on the environmental performance of their suppliers. ELV regulations differ from country to country. Herein, we will take the European End-of- Life Vehicle Directive (2000/53/EC) as our point of departure. On 21st October 2000, Directive 2000/53/EC entered into force, and the 21st April 2002 was the final date for implementation in member states. The objectives of the Directive are: (1) to prevent waste from ELVs; (2) to promote the collection of ELVs; (3) to promote re-use and recovery of ELVs (e.g. components) to protect the environment (European Commissions, 2001).

To prevent waste from ELVs

In order to prevent waste from ELVs, the Directive states that car manufacturers and material and equipment manufacturers must (Article 4):

Endeavour to reduce the use of hazardous substances when designing cars;

Design and produce cars that facilitate the dismantling, re-use, recovery and recycling of ELVs;

Increase the use of recycled materials in car manufacturing;

Ensure car components placed on the market after 1 July 2003 do not contain mercury, hexavalent chromium, cadmium or lead, except in cases detailed in Annex II.

To promote the collection of ELVs

The Directive also introduces provisions for the collection of all ELVs (Article 5). Member states have to take the necessary measures to ensure that economic operators (i.e. producers, distributors, collectors, motor vehicle insurance companies, car-dismantling companies, shredders, re-

coverers, recyclers and other treatment operators of ELVs) set up systems for the collection of all ELVs and check that there is adequate availability of collection facilities. Member states also have to set up a system in which the last owner needs a certificate of destruction in order to be able to de-register his or her car. Only authorised car-dismantling companies are able to issue a certificate of destruction. Car-dismantling companies will only be authorised when they comply with a number of requirements aimed at the protection of the environment. Furthermore, the last owner of a car should always be able to deliver it free of charge to an authorised car-dismantling company ('free take-back' principle), even when the car has a negative market value.

To promote re-use and recovery of ELVs to protect the environment

At the moment, at least 75% of the ELV's weight is recycled (metal content). Directive 2000/53/EC, means the aim is to obtain the following targets (article 7 §2):

No later than 1 January 2006, for all ELVs, re-use and recovery shall be increased to a minimum of 85% by an average weight per vehicle and year. Within the same time frame, re-use and recycling percentages shall be increased to a minimum of 80% by an average weight per vehicle and year;

No later than 1 January 2015, for all ELVs, re-use and recovery shall be increased to a minimum of 95% by an average weight per vehicle and year. Within the same time frame, re-use and recycling shall be increased to a minimum of 85% by an average weight per vehicle and year.

In accordance with the polluter-pays-principle, car manufacturers will be responsible for the collection and recovery of ELVs. Additionally, they must integrate an increased amount of recycled material into the design and manufacture of new cars. With certain exceptions, they must also take back ELVs from the last owner free of charge. This is an expression of the producer's responsibilities. Owners of an ELV that is non-recyclable, and therefore has a negative market value, will be entitled to claim compensation from the manufacturer for any costs incurred in transferring their ELV to an authorised car-dismantling company. Furthermore, collection and recycling of ELVs must not be a burden on public authorities. Rather, it will be a task for economic operators in the car chain.

The second objective – to promote the collection of ELVs – can be achieved in a relatively short time. This will mainly reduce local environmental problems, however. Dismantling by authorised companies should mean that no ELVs are dumped in nature. Member states can enforce different public environmental regulations on the authorisation of car-dismantling companies. Danish car-dismantling companies, for example, must have either a certified ISO 14001/EMAS Environmental Management System (EMS) or an ISO 9002 certified Quality Management System. Whether or not car-dismantling companies have to have a certified EMS, the focus is undoubtedly on a process-oriented strategy. Single companies can adopt a process-oriented strategy because co-operation with other actors in the chain is less critical than in a product-oriented strategy. The product-oriented strategy will be elaborated in the next section.

Product-regulation

During the 1990s, product-oriented strategies have been more frequently employed in the regulatory approach of many industrialised countries. The main objective of product-oriented policy is to establish a situation wherein actors in the product chain continually strive for a decrease in environmental pollution of a product (Smink, 2002). Rather than looking at individual production processes, a product-oriented approach calls for an integral perspective, examining the material streams connected to production, consumption and disposal, i.e. the entire life-cycle of a product (Boons, 2002). ELV can be considered as an example of product-oriented regulation. Even though product regulation is relatively new, there are some examples in the car chain that date back as far as the early 1960s. As early as 1963, California required simple emission control on all new cars sold within its boundaries; the first regulation of its kind. In 1970, Congress passed the Clean Air Amendments. These called for strict standards on the three major air pollutants emitted by cars (i.e. Hydrocarbon, CO and NOx). The US Environmental Protection Agency (US EPA) established regulations for cutting back car emissions to meet these standards. Government did not tell car manufacturers how to reduce car emissions; the choice was left to them. Before cars were sold, however, they were subject to certification by US EPA to ensure they met the standards. All imported cars also had to meet the emission standards (U.S.EPA, 1975). These US standards influenced those in several other countries. Europe, however, has consistently lagged in emission legislation (Nieuwenhuis & Wells, 1997).

Between 1988 and 1993, the European Community (EC) formulated various environmental regulations. Final decisions on these regulations were delayed several times, however. Consequently, several member states introduced stricter standards unilaterally. In Europe, one of the first initiatives to regulate the car in the in-use phase was the 1985 introduction of unleaded petrol. Thereafter, the market share of unleaded petrol increased from 6,8% per year to 75% by 1997 (EEA, 2000). Directive 98/70/EC aimed at an almost complete phase-out of leaded petrol by 2000. This was, however, delayed and a complete phase-out will not be achieved before 2005 (EEA, 2000). Other, more recent, EU-initiatives are the Auto-Oil Programme I and II, and the Clean Air For Europe programme (CAFÉ). Furthermore, in 1998 the EC and the European auto industry (ACEA) concluded a voluntary agreement aimed at reducing CO2-emissions from new cars. The objectives of the agreement (European Commissions, 1998) are:

To achieve an average CO2-emission of 140 g/km by 2008 for all its new cars sold in the EU;

To bring to the market individual car models with CO2-emissions of 120 g/km or less by 2000;

To achieve an indicative intermediate target in the order of 165–170 g/km in 2003 as the basis for monitoring progress;

To review the potential for additional improvements with a view to moving the new car fleet average further towards 120 g/km by 2012. This review will be undertaken in 2003.

Corporate responses – process or product-oriented strategy?

In this section we investigate how companies have reacted to environmental policies within the car chain field. In section 2 developments within environmental regulation were briefly described. It was stated that development in the direction of a product-oriented strategy could be observed in some industrialised countries. In this section, the impact of such development within the car industry will be elaborated upon. In order to comply with the ELV-regulations described in section 2 car manufacturers have to respond to a product-oriented strategy. In section 2.2, several articles from the EU-Directive 2000/53/EC have been quoted to illustrate that car manufacturers have to play a significant role in the prevention of waste from ELVs and in the promotion of reuse and recovery of ELVs. But what do car manufacturers actually do? In order to answer this question, we have taken the environmental policy of two car manufacturers (BMW and GM) as points of departure. After examining the policy and strategy of these companies, we focus on interviews - conducted in November 2002 - with staff at the South African assembly plants of each manufacturer. Do these companies have the same environmental strategy as their parent company? Does the parent company pass on environmental information?

Before answering these questions, however, we should – very briefly - describe the automobile industry in South Africa. In 1924, Ford opened the first assembly plant in Port Elizabeth. General Motors (GM) followed two years later with its first assembly plant, also in Port Elizabeth. During the apartheid era, many manufacturers – including Ford and GM – withdrew from the country. Following the demise of the apartheid regime, however, these car manufacturers returned. Since 1994, exports of automobiles built in South Africa have increased substantially. Today, the South African automotive sector is the third largest in the country, only trailing mining and financial services (Nöffke, 2002). There are currently seven car manufacturers operating in South Africa.

BMW: Environmental strategy of the parent company

In a speech at the World Summit on Sustainable Development in Johannesburg in 2002, Dr. Norbert Reithofer, member of the Board of BMW, stated that ”the issue [of sustainable development] is not environment versus development, or ecology against the economy. Contrary to popular belief, we can integrate the two (…)”. BMW is firmly convinced that sustainability is not a distant vision. “It is the core of our current company strategy and it establishes the foundation for the future of the BMW Group as a global provider of premium cars and motorcycles”. In the same speech Reithofer states that environmental protection is an important aspect of BMW’s environmental policy. BMW has opted for the instruments Design for Recycling (DfR) and Life-cycle Assessment (LCA) for the integration of environmental and recycling standards. Already in the developmental stage, a recycling-oriented design process takes the dismantling aspects of the vehicles into account. As a result, Reithofer argues, “all our vehicles are almost completely economically recyclable”. Another focus with regard to environmental protection means that all BMW production plants have an EMS certified according to ISO 14001 and/or EMAS.

BMW: Environmental strategy of the South African assembly plant

BMW South Africa is owned by the BMW group and is covered by the corporate management of BMW. In 1999, the Rosslyn BMW plant in South Africa received certification for its integrated management system for quality, work safety and environmental protection in compliance with ISO 9001, ISO 14001 and BS 8800. The company has reduced environmental impacts, risks and accidents considerably. From 1998 to 2001, for instance, it reduced water and electricity consumption per manufactured vehicle by around 90% and 45%, respectively (BMW, 2002b). In 2000, BMW South Africa integrated a supply chain management programme into its environmental management system. The initial target was that all suppliers should have a certified EMS - or they would be replaced with others who had. The programme was designed to provide key suppliers with support to help them adopt an EMS.

In early 2002 when the programme was initiated, 28% of suppliers were certified according to ISO 14001. By November this had increased to 50%. By the end of 2002 BMW South Africa expected 70% of its suppliers to be ISO 14001 certified (BMW, 2002a, BMW, 2002b). In the course of implementing this programme, however, BMW realised that aiming at an EMS for all suppliers was too high an ambition. For some of the small suppliers an EMS was too complicated and expensive. BMW therefore decided to manage its smaller suppliers via Environmental Audits. The argument ran that an EMS was a tool mainly for continuous improvements, which were not necessary in all cases. BMW realised that an audit was just as effective in ensuring that the environmental performance of certain suppliers was in line with its aims.

GM: Environmental strategy of the parent company

According to their sustainable report, GM is dedicated to protect human health, natural resources and the global environment. "At GM, Sustainability drives us to be systematic and proactive in seeking continuous improvement in our operations and products in a way that integrates economic, environmental and social objectives into our business decisions" (GM 2003a). In 1994, GM was among the first manufacturing companies to formally endorse the CERES Principles.

It was seen a step in affirming GM's commitment to environmentally responsible business activities. The original expectations of the involvement in CERES were continuous improvement in terms of:

Public accountability and corporate disclosure

Plant environmental performance

Product performance

In relation to Sustainable Development, GM have actively been involved in the World Council for Sustainable Development (WCSD) and also participated at the 2002 earth summit in Johannesburg. GM's environmental policy and strategy have evolved in accordance with the degree of its involvement in such environmental fora. In practice, the environmental strategy is directed towards the products as well as the manufacturing processes.

GM have adopted a number of programmes within their environmental strategy such as recycling, resource management, product design, supply chain management etc. In principle, it seems that GM has established environmental policies in all relevant areas. From their Internet homepage it is hard to judge how widely these policies and initiatives have been implemented, however. GM attaches great importance to co-operation with other actors in the chain. In this respect, GM required in 1998 that its top 600 vehicle parts suppliers become certified to an Environmental Management System equivalent to ISO14001 by the end of 2002. This requirement applies, in principle, to all suppliers that provide parts to GM and that have a significant environmental impact.

It is GM's goal, that all production facilities have an ISO 14001 certified EMS if they have a significant environmental impact. With the advent of ISO 14001, GM redesigned the existing environmental management framework that covers GM globally. GM's EMS includes several additional requirements that place increased emphasis on supporting environmental performance and cost reduction activities. These elements provide a global and common framework plus specifications to help understand how individual plants interact with the environment, and to improve management of these plants in an ongoing cycle.

GM: Environmental strategy of the South African assembly plant

Delta Motors is 51% owned by its South Africans directors and 49% by General Motors North America. The company produces various vehicles in GM´s series (i.e. Opel, Isuzu and Suzuki). Yet, Delta Motors is not ISO 14001 certified. The company began building up its EMS in 2000 and the system was implemented by mid 2002. According to the Environmental Manager the provisional date for a Certification Audit is set for the end of October 2003. Senior management have been reluctant to persue a certified EMS because they are not convinced of the financial pay off. Delta Motors considers an EMS as primarily a condition for continuing as an agent in the export market in the future. In this regard, they are under increasing pressure to comply with the principles of GM. If GM fully realise their corporate strategy over the coming year, for instance, Delta Motors will have to react to the parent company's demands on their suppliers. Whether, given the stock holding, General Motors can be considered as a genuine 'parent company' is open to question. Nevertheless, on their homepage GM has listed Delta Motors as one of their plants, although it is actually only part owned by them (GM 2003b). In cyberspace at least, then, GM does not distinguish between plants that are wholly owned and those which are part owned. To date, GM have conducted environmental audits at Delta Motors and made a report highlighting a number of deficiencies that they want to address. In response, Delta Motors have formulated a number of environmental targets and improved their environmental performance. They have, for example, reduced spills considerably and implemented robotic spraying, which reduces the paint and solvents used.

The Environmental Manager at Delta considers ISO 14001 as an instrument for solving the environmental challenges that GM highlight (Delta Motors, 2002). All in all, however, the attitude of Delta Motors towards environmental performance does not match the principles outlined by GM. There is evidently a gap between GM's vision and environmental practice at Delta Motors.

Conclusion

Both GM and BMW have been successful in motivating their South African assembly units to introduce EMS. However, the nature of the environmental effort reflects the environmental policies of headquarters rather than the local environmental situation. The environmental focus of both assembly plants is primarily directed towards issues that emerge from the targets of the parent companies. The environmental strategies of the assembly plants are, moreover, focused on improving existing technology and environmental performance. In other words, their EMS is largely process- rather than product-orientated. In adopting the framework for their EMS it seem that it has primarily been a one-way communication and co-operation process between 'headquarters' and the assembly plants. This type of communication and co-operation is evidently less progressive than the one illustrated in figure 2.

The environmental policy of subsidiary companies needs to be more integrated into the South African context. One way of doing this is to set environmental targets that reflect both the environmental situation in South Africa and, at the same time, comply with the environmental policy and strategy of 'parent' companies. National environmental regulation is not very developed and therefore it is more difficult for South African companies to identify significant environmental problems. The authorities are not playing the role of identifying problems and specifying targets for solutions. Weak enforcement means that the assembly plants experience difficulties even in determining whether or not they are in compliance with regulation. Though it is our impression that the companies are actually operating 'beyond compliance', it should still be noted that a focus on EMS does not particularly reflect national or local environmental needs.

At the BMW assembly plant, some of the activities can be described as product-oriented towards their suppliers. In three years, BMW has been able to implement supply chain management. It has also been flexible in relation to small companies, introducing environmental auditing rather than a certified EMS as a condition of continuing collaboration. It is our impression that BMW has thus been able to improve the environmental performance of its suppliers. To a certain extent, then, BMW in South Africa has been able to implement the vision of the parent company with respect to EMS in the product chain. By contrast, the environmental activities at Delta Motors could be described as a process-oriented policy. It seems that Delta have not been actively involved in GM's supplier programme on EMS. Though they focus on implementing an EMS, the decision to have the system ISO 14001 certified still needs to be taken. Delta Motors, it seems, has not yet taken the steps necessary to claim a product-oriented strategy. Meanwhile, ELV aspects and product improvements such as fuel efficiency seem to be absent in the EMS of BMW (South Africa) and Delta Motors. Both companies pointed out in interviews that the parent company must take responsibility for these issues in the product design phase. If product orientation is to have a global impact, then the parent companies must develop their policies in a way that it is also relevant in a developing country context. The ELV policies of the parent companies are not developed in way that the assembly plants can integrate it in their EMS. It is our impression that this can, in fact, only be achieved if communication and co-operation is intensified and becomes genuinely two-way.

Both South African companies must improve the product-orientation in order to fulfil the environmental policies of their parent companies. In order to deal with environmental aspects in the entire product chain, we believe that the parent companies must establish a closer and more intensive interaction with all the actors in the product chain. The benefits of a closer and more intensive interaction are that policies can be adjusted in line with the situation and the experiences of subsidiary companies. An active use of dialogue will also help to ensure that the framework and policies for EMS can be more easily adapted for the subsidiary companies.

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Environmental management systems in South Africa – a case study in the automotive industry

By Tine Herreborg Jørgensen and Carla K. Smink

Summary

The aim of this paper is to present and discuss some of the empirical findings regarding environmental management systems (EMS) of four companies in the automotive industry in South Africa. Environmental management systems can according to ISO 14001 be viewed as a travelling concept that is appropriated to different contexts. The concept of environmental management is shaped due to conditions such as interests and demands of different stakeholders, the regulatory framework, market structure, organisational identity, educational systems, accreditation bodies, available equipment and production facilities. Not only ISO 14001 has been translated from one language to another, when travelling, the whole concept and understanding of the environment is translated and transformed, in order to perform in a new context.

South Africa has been chosen, as it belongs to a part of the world, where currently, the ISO 14001 is not so widely spread and as South Africa has far the most ISO 14001 certificates in Africa. The choice is to investigate transnational companies in the automotive industry and the supplier relations to the Parent Company and a business with increasing international environmental regulation.

The paper will investigate the incentives for becoming certified according to ISO 14001 and experiences with a certified environmental management system: the organisational changes which the companies have gone through with focus on implementation and operation. An investigation will also take place concerning, to what extent the EMS promotes environmental improvements. Furthermore, the environmental regulation and the role of environmental authorities will be analysed. Finally environmental considerations regarding the product chain are discussed. Some of the findings will be compared to Danish and international experiences.

Appropriation of ISO 14001

The existing consumer patterns in the industrialised parts of the world, the global character of today's environmental problems and the expansion and increasing complexity of the global market place demand a response from all countries and from all levels of society.

Through the 1990s and until today, this development has resulted in an increasing pressure on industry, especially in the most developed countries. This pressure derives from the demand that companies should take responsibility for the environmental damage which they create and thus approach their way of managing the environment in a more systematic and proactive way (Welford, 1998).

Environmental concerns are being incorporated in an increasing number of business strategies, in order to meet the environmental demands from the different stakeholders or to create a market demand for greener products. Many companies have integrated the responsibility for pollution prevention in their management system, where actions have to take place, in order to reduce the environmental impacts. The increasing interest among companies for self-regulation in relation to their environmental impacts has resulted in a need for methods and tools to support reliability and the process of change towards systematic development of cleaner production processes and products. Since the mid 1990s, with the publication of ISO 14001 (ISO, 1996), almost 50,000 companies have obtained a certified EMS (ISO, 2003). ISO 14001 is an international standard which could have a number of opportunities for an organisation (ISO, 2002):

A structured approach to addressing the environmental bottom line

To manage the impact of their activities on the environment better and to demonstrate sound environmental management.

Improved environmental performance.

Addresses not only environmental aspects of the production processes but also those of its products and services.

Can improve environmental management and enables equal access to a growing “green” market place.

ISO 14001 is an international standard with the purpose of use in many different types of organisations. The standard does not, and is not intended to contain many specific requirements (Bell, 1997). ISO 14001 is a framework that companies are obliged to adopt into their organisation. However, the standard does not specify how the requirements should be met and also they do not provide an indication of the goals which it should strive to achieve (Schaltegger et al., 2003). ISO 14001 is a process standard and not a performance standard, meaning that the standard does not set up specific demands of environmental improvements. IS0 14001 is flexible with room for interpretations, such as implementation strategies, definition of scope, environmental improvements, internal and external communication and co-operation.

An EMS according to ISO 14001 can be considered as a travelling concept both at national and international levels and appropriated to different contexts. The concept of environmental management is shaped due to conditions, such as interests and demands of different stakeholders, the regulatory framework, market structure, organisational identity, educational systems, accreditation bodies, available equipment and production facilities.

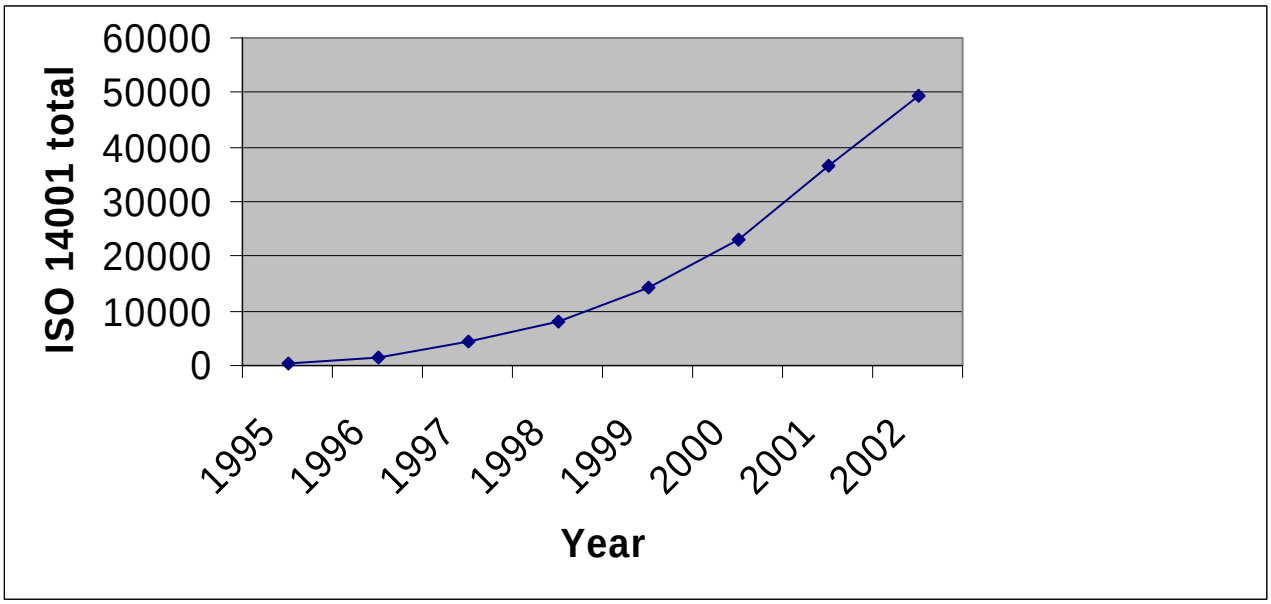

Figure 1: World-wide total of ISO 14001 certificates Dec. 1995 to Dec. 2002 (ISO, 2003).

In the appropriation process, the interpretation of the surrounding environment shapes the organisations definition of environmental problems and impacts, and problem solving strategies. Not only the ISO 14001 has been translated from one language to another. When travelling, the whole concept and understanding of the environment is translated and transformed, in order to perform in a new context.

Internationally, the interest in implementing an EMS has increased rapidly as is illustrated in figure 1. In total 49.462 ISO 14001 certificates were issued by 31st December 2002 covering 118 countries (ISO, 2003).

Looking at the share of ISO 14001 certificates in different parts of the world, it shows that Europe (47%) and Far East (36%) together hold 83% of the certificates (table 1). Other regions in the world have had a slower and/or a later start. From 1995 to 2002 the number of ISO 14001 certificates has increased every year in all different parts of the world. Though Europe's share is decreasing, the Far East are still increasing their share of the certificates. In regions characterised by developing countries (Africa/West Asia and Central/South America) the share is very little and it seems to stay low. This tendency is the same for the ISO 9001 for quality management systems, QMS (ISO, 2003).

Introduction to case studies in South Africa

The empirical basis of this paper is an analysis and an assessment of four case studies in the automotive industry in South Africa. South Africa has been chosen for the studies, because it belongs to a part of the world, where currently, ISO 14001 is not widely spread (Table 1).

Region	1995 (%)	1997 (%)	1999 (%)	2001 (%)	2002 (%)	Total number Of ISO 14001 Certificates
Africa/West Asia	0,4	1,7	2,4	2,5	2,7	1,355
Central and South America	1,2	2,2	2,2	1,9	2,9	1,418
North America	0,4	2,6	6,9	7,4	8,2	4,053
Europe	87,9	59,2	52,2	49,6	47,1	23,316
Far East	9,7	30,6	30,8	34,8	35,9	17,757
Australia/New Zealand	0,4	3,7	5,5	3,9	3,2	1,563

Table 1: Share of ISO 14001 certificates in different regions of the world 1995 to 2002. (ISO, 2003).

Today South Africa has far the most ISO 14001 certificates in Africa with 264 certificates by 31st December 2002. The next in line are Morocco (11), Zimbabwe (5), Namibia (4), Nigeria (4). (ISO, 2003). The automotive industry is chosen because it is can be considered of one of the most polluting product in a life cycle perspective and it is a business with increasing international environmental regulation, for instance to proper environmental dismantling of cars.

In November 2002 interviews were made in South Africa with four companies in the automotive industry, as illustrated in Table 2. The basis for the interviews were the following questions:

Respondents/Company	Business/Activity
BMW (Pretoria)	Assembling of cars
Delta Motor Corporation (Port Elisabeth)	Assembling of cars
Bridgestone Firestone (Port Elisabeth)	Tyre production
Continental (Port Elisabeth)	Tyre production
SABS(Pretoria)	Certifying body
BVQI (Pretoria)	Certifying body
Brett Williams (Port Elisabeth)	Environmental consultant

Table 2: Respondents of interviews conducted in November 2002 in South Africa.

What are the incentives for becoming certified according to ISO 14001?

What organisational changes have the companies gone through?

Have the EMS promoted a radical technological change, environmental improvements and greening of knowledge?

What are the relationship with stakeholders, and have they been strengthened?

An environmental representative from each company was interviewed, documentation of their EMS was viewed and finally a tour on the plants took place. Lead auditors from two certifying bodies and an environmental consultant in South Africa have also been interviewed. The empirical basis of the paper is the interviews with these respondents. BMW is a Daughter Company of BMW in Germany and Bridgestone Firestone is a Daughter Company of Bridgestone in Japan. Delta Motor is a supplier to General Motor in North America who owns 49% of Delta Motor and Continental is a supplier to various customers.

Company	**ISO 9001 Certification (year)**	**ISO 14001 Certification (year)**	**ISO 14001 Implementation start (year)**	**BS 8000 Certification (year)**
Bridgestone Firestone	1990	1999	1998	No
Continental	Yes	1999	1998	No
Delta Motor Corp.	Yes	No	2000	No
BMW	Yes	1999	1999	1999

Table 3: Year of certification of the four companies interviewed.

Incentives for ISO 14001 certification

In the case studies in South Africa three of four companies have an ISO 14001 certification as illustrated in table 3. All four car companies have a certified Quality Management System (QMS), ISO 9001, and one company has a certified Occupational Health and Safety Management System (OHSAS), BS 8000.
The reasons, why the four companies decided to implement an EMS, were partly the expectations of future demands from customers and partly the pressure from their Parent Company. For many years, the export markets for automobiles have demanded that a basic QMS is in place at their suppliers. Today, the demand for an EMS has been strengthened and as the Parent Companies in the automotive industry are aware of this, they try to motivate and encourage their suppliers to implement ISO 14001.

The main reason, why BMW has implemented an ISO 14001 certification was that the Parent Company in Germany demanded that all assembly units were to implement an EMS according to ISO 14000. “The demand from the Parent Company is also the demand from the customer”. (BMW, 2002). Continental has been certified according to the ISO 14001, because of customer demands from for instance BMW.

Bridgestone Firestone began to implement their EMS three years before the demand for an ISO 14001 certification was put forward by their Parent Company. They feared that without the certificate, they would not be able to provide export in the future: “It would be nice to say that we did it”. For the same reason, they went into ISO 9002 for QMS in 1991 (Bridgestone Firestone, 2002).

Delta Motor has not yet been certified according to ISO 14001. They began the process of implementation in year 2000. The main driving forces were the possibilities of export and the fact that other automotive industries already were ISO 14001 certified, such as BMW. General Motor

made an environmental audit at Delta Motor and came up with a report including a number of gaps, which they wanted to have addressed. By means of an ISO 14001, Delta Motor wanted to close those gaps. Most of the EMS has been implemented by mid 2002 and the provisional date for certification audit is set to the end of October 2003. The decision of an EMS certification was not made earlier due to the return of investment considerations (Delta Motor, 2002).
Most of the ISO 14001 certificates in South Africa seem to have been issued among the larger firms, while only few SMEs have received the accreditation. Besides, when compared to many of the larger firms, the market of the SMEs are often domestically and as they still are to experience supply-chain pressure, the incentives seems rather limited. (Jeppesen, Søren, 2003). The incentives for becoming certified according to ISO 14001 differs between Denmark and South Africa. In the four case studies the primarily incentives are export considerations and pressure from the parent company. In Denmark the most frequent reasons for the companies to become certified is a desire of being/becoming the frontrunner within environmental issues and considerations regarding image and reliability (Christensen et al., 1999). The general image and reputation of most companies are crucial for their reliability and trust of the customers, authorities, and the civil society. With stakeholders growing interest in the environmental impacts of industry and their products, the environment increasingly becomes part of companies´ overall policies (Jørgensen, 2001). In general, it seems, as if especially the large multinational companies and companies from developed countries/recently industrialised countries operating on international markets demand/motivate their suppliers in developing countries to become ISO 14001 certified (Morrow and Rondinelli, 2002).

Integration of an EMS in the corporation

Especially during the last five years, the environmental awareness in the four companies has increased, as they have either implemented a certified EMS or they have been working on it. This has affected the internal organisation. In all four companies, the implementation of the management system started from the top with only few people involved. After the certification, the responsibilities regarding the system has slowly dispersed to more people and to lower levels in the organisation.

At BMW the environmental department consists of an environmental manager and two assistants. During the implementation of ISO 14001, which was carried out in only half a year, an environmental consultant from the head office in the environmental department of BMW in Germany came to assist the company. The consultant was very dynamic and he managed the implementation within the company and they successfully obtained the certificate. But afterwards, when the consultant left, the environmental activities stagnated for about a year. It was a challenge to consolidate the system in the organisation. Today an environmental manager is employed and environmental improvement projects have been organised. One of the environmental activities is a monthly competition between the different areas of the company called: “The Safety, Health, Environmental and Housekeeping competition”. The director shakes the hands of the winning workers and gives them a small trophy. This has become a sport for the employees who normally do not have a chance of meeting the director. “The environmental progress is quite phenomenal. Small things, especially on the safety side, walk ways, electrical…all of those have been new projects identified...on the environmental side for e.g. pick up small things like the chemicals not

labelled properly, then find out why and how did it get there. And you can keep identifying problems, which you would not otherwise be aware of." (BMW, 2002).

At Delta Motor, the environmental department reports directly to the director of manufacturing. Previously, they reported to the production manager, one step lower in the organisation. In addition, an environmental officer has been employed in a new position. At Bridgestone Firestone the environmental manager carried out the implementation primarily on his own. In the beginning, education of the employees was the responsibility of the environmental manager, but today two native workers are responsible for the communication and the training. The two workers are not managers, but they have showed an interest in the EMS and on that basis, they were chosen for the job. Today the EMS is divided into smaller areas, where each manager keeps his own book with environmental aspects and impacts for his department. Currently, they focus more on the work force at the shop flour. Today at Continental environmental issues have moved up on the agenda in connection with a shift in the management.

All four companies have used the ISO 14001 standard as the basis for their EMS. The companies are used to working with the standard for quality management systems, ISO 9001, and find it natural to work with the international standard for EMS.

Environmental awareness and training

In general, the educational level of the employees at the shop floor of the four companies is rather low (Bridgestone Firestone, 2002), (Delta Motor, 2002). The employees often only have primary school as their educational basis. Therefore, some of the employees are not able to comprehend and read English. With this educational background, the environmental awareness initiatives must start at a basic level. The companies are aware of this fact and they are requiring stricter educational levels from people to get into the company. Not only from an environmental point of view do the companies now insist on a higher educational level for new employees. Also due to the fact that they want to be able to use more advanced technologies and to give carrier possibilities, in order for shop floor workers to get managerial positions (Bridgestone Firestone, 2002).

At Continental, they have carried out a range of training and awareness programmes at all levels in the organisation. At the shop floor talks are given and written information about safety and environmental issues is presented and all employees have to verify whether they have participated and whether they have read the information. "There is a massive improvement on the awareness of the employees, the managers and everyone" (Continental, 2002). The environmental manager gave an example from the day before the interview, where something went down the drain, and was not supposed to. Before she would not have been informed about it, but today she is informed immediately by telephone. The environment, health and safety manager today has daily meetings with managers from the engineering and the production department, in order to inform about and to reduce environmental problems. At the meeting, she reports on problems, which have occurred during the day. Once a week she has a meeting (of half an hour) with all the managers in the two departments. They go through inconformances of the EMS and who is responsible for corrective actions.

BMW runs a training programme on an annual basis for all employees at the shop floor. The environmental representatives and the middle management participate in external ISO 14001 courses. These years they spend a lot of time on legal requirements, because they have to keep up with the changes. The environmental representatives train the team leaders to do morning pep talks for the employees.

The establishment of an environmental management system and the demand for continuous improvements is a process towards reduction of the companies´ and the products´ environmental impact. The organisations´ ability to change is crucial in order to establish a dynamic environmental management system and to achieve continuous environmental improvements. In an in dept study of two Danish companies in the food sector and their organisational changes in relation with their EMS have similarities with the findings in the case studies in South Africa. The two companies have during the last 8 years gone through a strong development and change. The informal structures and decision-making processes have been formalised in order to comply with the demands in the ISO 14001 standard. The management of the environment has been extended and at the same time some tasks and decision-making competencies have been delegated to lower levels of the organisations. The two Danish companies have introduced a more proactive environmental strategy and the organisations adapt faster to new demands from stakeholders. Today the external communication is based more on openness and dialogue. (Jørgensen, 2000), (Jørgensen, 2001).

Environmental improvements

Several studies show that organisations certified according to ISO 14001 result in environmental improvements and cost savings for the majority of the organisations (Christensen et al.; 1999), (Kwon et al., 2002), (Melnyk et al., 2002). For instance in a survey with about 1,000 respondents it is concluded that “Basically, a formal EMS does play a role in improving overall performance; it also affects the frequency with which various environmentally related options are used. Furthermore, certification of these systems does have a significant incremental impact on performance and on the reactive options the plants involved in the study considered” (Melnyk et al., 2002). Though case studies of ISO 14001 certified companies in Thailand have shown examples of poor environmental management and acceptance of non-regulatory compliance among external auditors (Lauridsen and Jørgensen, 2003). In an article from 2001 it is also stated that complying with regulation is not a necessary precondition for an ISO 14001 certification (Wätzold et al., 2001, p.39). In Denmark companies must comply with environmental regulation when they are certified (Jørgensen, 2001). In the next years many companies in developing countries must obtain an ISO 14001 certificate in order to enter the international market. In this respect it is of great importance that the certificate has credibility.

Still more large-scale studies of the effects of ISO 14001 need to be carried out. This should bring more general applicable results, in order to achieve a better insight in the benefits of EMS at international level and differences between countries. (Ammenberg, 2001), (Melnyk et al., 2002), (Morrow and Rondinelli, 2002). But also in order to verify the reliability of the ISO 14001 certificate. The validity of most existing quantitative studies measuring environmental performance in ISO 14001 certified companies can be questioned. First of all the number of certified companies that do not reply on questionnaires used in research are often high, and we do not

know why these companies did not reply and what impact they would have made on the results if they had participated. Secondly it must be investigated how companies that are not certified act and perform compared with certified companies. Thirdly it is of importance in a study to know how long the companies have been certified. It can take some time to generate effects but the first years after certification organisations often achieve a number of environmental improvements, “the low hanging fruits”, and over time improvements become smaller or are made in connection with technological jumps like investments in new technology. (Ammenberg, 2001), (Melnyk et al., 2002).

With the implementation of an EMS, the four South African companies have reduced their environmental impacts, risks and accidents considerably. BMW has for instance reduced water consumption per vehicle with approx. 90% from 1998 to 2001 and the electricity consumption with approx. 45% from 1998 to 2001 (BMW, 2002b). Closing loops and recycling of water made some of these reductions possible. Both their own technical department and external assistance have participated in the reductions. Now BMW has installed water meters and electricity meters in each department to monitor the impacts per department. This will help identifying the largest users of water and energy and to aim at reductions within those places.

At Continental, the percentage of hazardous waste per kilogram rubber has been reduced with more than 50% in the period of 2000-2002. Water, electricity and oil per kilogram rubber have also been reduced with more than 25% in the period of 2000-2002. At Delta Motor they have for instance implemented robotic spraying which considerably reduces the amount of paint and solvents used and stricter controls and modifications to the wastewater treatment facility. Usually they had a spill 2-3 times a week. Today with their EMS, they only have spills 2-3 per month. They have formulated a number of environmental targets, for instance reducing energy consumption, reducing hazardous waste disposal and improvement in fuel efficiency of products (petrol).

All four companies use scoring/rating systems as basis for determination of significant environmental impacts and for prioritisation of their environmental impacts. All companies have formulated a number of environmental targets for the next years. The environmental efforts do not reflect a change towards life cycle management and end-of-vehicle aspects are absent. A further discussion of these issues can be viewed in (Smink et. al, 2003).

Compliance with legislation

In the four case studies, the most difficult part of complying with ISO 14001 has been the environmental legislation of South Africa. Environmental legislation in South Africa has a number of problems regarding enforcement and comprehensiveness (Kidd, 1997). It takes a great amount of time for the companies to gain an overview of the legislation to comply with. They find the law very extensive and incomprehensive. Bridgestone Firestone has made an agreement with a lawyer to interpret the laws and express the essence in a few pages and in a comprehensive language. The environmental manager has a close relationship with the head of the local environmental authorities and stays in direct contact with him to discuss environmental matters. At Continental they also use external assistance. They get a monthly update on any changes in laws in

South Africa, including environmental legislation. At BMW they have joined a number of courses to achieve the necessary knowledge about the environmental regulation in South Africa. (Bridgestone Firestone, 2002), (Continental, 2002), (BMW, 2002).

In South Africa there are three levels of legislation: national, provincial and local/municipal. On the national level, legislation is fragmented between various governmental departments. Today nine different systems of provincial environmental legislation exist. The national environmental policy and legislation needs to be strong and provincial initiatives should not depart from this (Kidd, 1997). In absence of South African legislation, it sometimes happens that the EPA guidelines for air pollution are used in relation with EMS. As for smoke and water pollution, the Dutch intervention guidelines are often used (Williams, 2002).

The enforcement of environmental regulations is weak because of limited government resources: "They (the municipality eds.) do not actually enforce anything, if we did not want to improve the environment we could do some nasty and horrible things"…"Basically it is entirely up to the company to ensure that they run according to strict regulations" (Continental, 2002). For instance the companies have to contact the authorities themselves in order to ask for specific pollution permits. The companies also take their own water samples, as the municipality does not have the resources to take care of this. Besides, sanctions for non-compliance with environmental laws are often not recognised by the authorities (Nthunya, 2002).

The case studies show that the companies with a certified EMS have difficulties obtaining an overview of what to comply with and spend a lot of resources in order to secure compliance with legislation. They complain about the complexity of legislation and the lack of enforcement of legislation. The case studies also show that the four companies make a great effort to secure compliance with environmental regulation. A survey from Korea comparing ISO 14001 certified companies with non-certified shows, that in 1998 regulation violation rates in certified companies were 8 times smaller (1,0%) than in non-certified companies (8,5%) (Kwon et al.). This indicates that ISO 14001 in general improve compliance with environmental regulation.

Regarding environmental pressure from authorities, a common problem of some developing countries is weak administrative and institutional capacities, poor regulatory enforcement and centralised systems. Even though given these conditions, an important stakeholder for improving environmental performance of industry could be the environmental authorities. In countries with weak environmental enforcement of authorities, ISO 14001 is a system which could play an important role of securing compliance with the environmental regulation and improvements of environmental performance for certified companies in the specific country. In a country such as South Africa, ISO 14001 can often ensure that certified companies comply with regulations. It could be considered to formulate legislation for the most polluting industries and demand an ISO 14001 certification audited by recognised certifying bodies. For instance, in Denmark the authorities demand one single trade of business, the car dismantling companies to have a certificate according to ISO 14001 or ISO 9001 as a condition for handling waste from motor vehicles (Miljø- og Energiministeriet, 1999). Most of the companies have chosen ISO 14001. In addition, sometimes the authorities demand that companies implement a certified EMS, as a condition for environmental approval (Lead auditor, 2001).

Another question to be raised is, “what is the differences in regulatory demands of the environmental law in different countries?” In some countries both the environmental law and the enforcement is weak. For a company with a certified EMS in such a country, it might be rather easy to comply with environmental regulation contrary to companies in other countries with stricter environmental regulation with stricter environmental demands and more control from authorities. As a consequence, some parent companies have formulated their own environmental standards, with which all subsidiary companies must comply, independent of their situation in the world. Customers with suppliers who are certified according to ISO 14001 do not necessarily know anything about, how strict environmental regulation is formulated in these countries. This means that customers to a certain extent should obtain knowledge about environmental demands in the countries of their suppliers in order to assess, whether it is satisfactory. Otherwise they should ask for and study the environmental reports of suppliers in order to decide if it is satisfactory.

Another important stakeholder in this relation is the public. In South Africa the environmental concern is growing (Kidd, 1997). Though, today the public seems to ignore environmental laws, because violators of the law are not punished (Nthunya, 2002). If more focus was put on certified EMS’ and the publication of green accounts, this could be a means to engage the public and this would perhaps result in more pressure on industry to improve their environmental performance. The fact that a company is certified according to ISO 14001 does not automatically inform stakeholders about, how polluting the production is compared to other companies. With ISO 14001 the company is only committed to publish their environmental policy and which is most often not sufficient, in order to assess and compare the environmental performance of two different companies for instance. EMAS registered companies in the EU have to publish an environmental statement which gives stakeholders a better opportunity to assess and compare environmental performances. With the increasing number of stakeholders who are concerned about the environmental impact and performance of industry, ISO 14001 could respond to this concern by integrating a demand for environmental statements in ISO 14001. Another way of providing public assess has been practised in Denmark since 1995 (revised in 2001) with a demand on the most polluting companies to deliver an annual environmental report no matter, whether they are certified or not (Miljø- og Energiministeriet, 2001).

Public assess to environmental information about performance in each company through environmental statements/reports would probably motivate some companies to make an extra effort in order to comply with environmental regulation and conduct continuous improvements of their environmental performance.

Supply chain management

Companies complying with EMAS/ISO 14001 in Denmark have recognised the responsibility for their own production, but not yet for the whole product chain (Christensen et al., 1999). Even though consumers, wholesalers and authorities are increasingly considering producers as responsible for the whole life cycle of their products, it seems as if life cycle thinking and specific demands for improvements by suppliers are still not very common (Kvistgaard et al., 2001), (Thrane et al., 2000).

A more product-oriented approach is necessary, because the most significant environmental impacts frequently appear in other life cycle stages. This is certainly the case for cars.

Environmental considerations of the supply chain in the four case studies vary. BMW has a policy regarding their suppliers. BMW argues that their suppliers contribute almost to 60% of the component value, and they impact directly on BMW's production which is the reason, why by the end of 2002, they want about 70% of their key suppliers to have achieved an ISO 14001 certificate (BMW, 2002b). This goal, they have already obtained (BMW, 2002a).

At Bridgestone Firestone, suppliers are encouraged to become ISO 9001 and ISO 14001 certified. At least two of their local suppliers are ISO 14001 certified. Regarding their suppliers overseas he says: "It is difficult to know what their situation is". He thinks that the head quarter in Tokyo should audit overseas suppliers, because the overseas suppliers provide material to many of their factories. At Continental they have an external company rating their suppliers in gold, silver, green etc. about health, safety and environment. Continental only accepts suppliers who have been rated.

BMW has taken the initiative to a waste club including the major industries within the area. They discuss and inform about environmental issues. Next step for BMW is to get a government representative and local environmental authorities to participate. BMW wants to provide the companies with guidance for improvements of environmental performance. For instance, it is difficult for individual companies to have access to all the new laws, and BMW are willing to share their knowledge about it. They do not want to be a company with high environmental performance, while the neighbours are still dumping stuff onto the road etc. (BMW, 2002). It is interesting that BMW, a transnational company, has put their own resources into organising the waste group, which is caused by lack of enforcement from the environmental authorities. The example of the waste club initiated by BMW show a new role of motivating and education the local industry, local authorities and NGO´s. This field could be of greater responsibility to the parent companies, in order to reduce environmental impacts. Not only on the sites of the suppliers, but also by supporting environmental consciousness in the broader local community.

Conclusion

The aim of this paper was to present and discuss some of the empirical findings regarding EMS of four companies in the automotive industry in South Africa. The paper investigated the incentives for becoming certified according to ISO 14001 and experiences with a certified environmental management system: the organisational changes, through which companies have gone with focus on implementation and operation. It has also been investigated; to what extent the EMS promotes environmental improvements. Furthermore, the environmental regulation and the role of environmental authorities have also been analysed. Some of the findings were compared to Danish and international experiences.

The primary incentive for the four companies to implement an environmental management systems have been the pressure form their Parent Company and it has also been partly due to the expected future demands from the export market and the fact that competitors have become cer-

tified. The environmental awareness in the companies has increased with the implementation of EMS. The implementation processes have been characterised by a top-down approach, but responsibilities are slowly dispersed to more people and to lower levels of the organisation. The environmental training of employees have improved the environmental awareness of employees at all levels of the organisations. Considerable environmental improvements have been conducted in all four companies. Reductions of for instance hazardous waste, water, electricity, oil and spills (risks and accidents) have been made. In these cases, there is no doubt that the environmental management systems with their formulation of goals and action plans have contributed to reductions of their environmental impacts. It has been very difficult for the four companies to gain an overview of the legislation to comply with. The legislation in South Africa is divided between national, provincial and local/municipal level. At national level, legislation is being fragmented between various governmental departments at national level. The companies find the environmental legislation extensive and incomprehensive. The municipality do not enforce regulations and the companies have to contact the authorities them selves to ask for formal pollution permissions. BMW has taken initiative to a waste club with the purpose of increasing the environmental awareness within the major industries in the area. They also try to get the environmental authorities involved. The major role of improving environmental awareness among industries would be expected to be the environmental authorities. But in this case BMW, a transnational company has taken this role due to the lack of activities from the authorities.

Environmental considerations of the supply chain in the four cases vary. At BMW they have initiated a programme for the sub suppliers to become certified. They made a goal in 2000 of having 70% of their key suppliers certified according to ISO 14001 by the end of 2002 and this goal has been achieved. In this case EMS have been disseminated like rings in the water upstream the product chain. At Continental they only accept suppliers who have been rated according to the environment and also to the health and safety. They do not demand ISO 14001 certification. Bridgestone Firestone encourages their suppliers to become certified and have succeeded with at least two suppliers. In general a more product-oriented approach to EMS should be promoted because the most significant environmental impacts frequently appear in other life cycle stages.

Developing countries and recently industrialised countries with limited resources for enforcement of environmental regulation could consider concentrating on the formulation of clear and appropriate environmental law and regulation towards industry. And also secure reliability of the national accreditation body. In some cases ISO 14001 certified companies do not comply with regulation and the lead auditors acceptance of that should be changed. At the same time new regulation could demand the most polluting companies to become certified according to ISO 14001. In this way, the lead auditors from the certifying bodies could control and secure that these companies comply with the law. It seems as the large companies in general are capable of implementing ISO 14001 and secure continuous improvements. More focus could there for be moved towards supporting the SMEs to become certified.

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Looking at the end-of-life directive and challenges in recycling - effective strategies and management

By Carla Smink

Introduction

The car industry is among the most powerful sectors of post-war industrial societies, with millions of people employed in car-manufacturing and related industries. The environmental image of this industry is often subject to debate. Some argue that our private-car based mobility system should be replaced by a radically different system, based on public transport. Others point to major achievements (e.g. catalytic converters, improved energy-efficiency etc.) that have been realised over the past twenty years or so, resulting in a reduction of the environmental impacts of the car. Here, focus is on the waste phase. In the EU and many other industrialised countries, so-called 'end-of-life vehicle' regulations (ELV-regulations) have been implemented especially over the last ten years. Examples in this article are mainly taken from the Netherlands and Denmark.

In this article, four aspects will be described. In the first place, attention will be paid to the EU Directive 2000/53/EC on end-of-life vehicles and the background of this Directive. When describing the background of the Directive, focus will be on EU's waste management policy, how the proposal to the Directive looked like and how different actors have responded to the proposal. The actors that will be portrayed are the ACEA (European Automobile Manufacturers Association) and the car-dismantling companies, represented by AGARA (European Group of Automotive Recycling Associations). As re-use and recovery of end-of-life vehicles (ELVs) is one of the main objectives of the Directive, definitions will be given of re-use, recovery and recycling. Next, focus will be on end-of-life vehicle regulation in the Netherlands and Denmark. Hereby, attention will be paid to the car chain and its two sub-networks. The use-, recycling and disposal network will be of major importance in this article. Attention will also be paid to the ELV-disposal structure in the Netherlands and Denmark, which problems have these countries faced with auto-recycling? Finally, it will be argued which efforts both the Netherlands and Denmark have taken to increase the recycling percentage of ELVs. The third aspect that will be touched upon is how the EU Directive on end-of-life vehicles has been implemented in Dutch and Danish legislation, in other words: where are we? Finally, based on the former aspects, I will answer the question: where do we need to be?

European end-of-life vehicle directive (2000/53/EC)

In this paragraph, I will pay attention to the European End-of-Life Vehicle Directive (2000/53/EC). I will start by describing the background of the ELV-Directive. Next, the content of the Directive will be described.

Although data on ELVs are not particularly accurate and not harmonised across EU Member States, it is clear that their number is continuously increasing. The estimated number of ELVs in the EU is projected to grow from about 11,3 million in 1995 to slightly less than 17 million in 2015 (EEA 2001).

Background of the EU-Directive on ELVs

The Council in its resolution of 7 May 1990 on Waste Management Policy, asked the European Commission (EC) to establish action programmes for particular types of waste. In 1991, the EC initiated the 'Priority Waste Streams Programme'. This programme aimed at six waste streams, one of these waste streams was ELV-waste. In December 1991, a European ELV-Project Group was established with representation from the ACEA, car manufacturers and their suppliers in the plastics, glass and steel industries, environmental groups and EU member states. In 1993, the ELV-project group published a report on the various scenarios associated with handling wastes from ELVs, including how to manage the collection and dismantling of ELVs.

In 1996, by Resolution of November 14, the European Parliament called on the EC to legislate on waste streams, in particular on ELVs, on the basis of producer responsibility. The EC had the view that a specific directive was necessary, given the importance of this type of waste. This position was shared by the OECD Working Paper on waste streams, whose 1995 report considered the treatment of ELVs as a priority towards the overall objective of reducing waste (European Commission 2001). In July 1997, the EC adopted a proposal for a Directive on ELVs (COM (97) 358). The EC came up with the following proposals (European Commission 1997):

Introduction of a certificate of destruction;

Focus on heavy metals;

Replacement of PVC by other materials (PVC in cars can be replaced by other materials. However, there is PVC in many products and the EC has decided that it would be more appropriate to tackle PVC problems horizontally rather than only in relation to ELVs).

Progressively increasing quantified targets for re-use, recycling and recovery;

Producer's responsibility.

Next, I will describe the opinion of two (groups of) actors on the EC's ELV-proposal, viz. ACEA and AGARA that represented car-dismantling companies.

ACEA's opinion on EC's ELV-proposal

The ACEA has been sceptical about EC's proposal. ACEA (1998) argued that over 75% by weight of a car is already recycled with minimum costs. ACEA repeatedly said that no other mass-produced item of such complexity is recycled at as high a rate as the car. They also made the point that 25% of the shredder residue was currently sent to landfill sites (roughly two million tonnes a year), which represented less than 0,2% of the total volume of waste in Europe (ACEA 1998). Car manufacturers stated that environmental pollution was mainly due to poorly controlled dismantling and recovery and stated that an improvement of standards in these areas would genuinely contribute to improving environmental protection strategies (CER 2000). 'Any pollution of the environment is caused primarily by inappropriate and unskilled dismantling and recovery. Accordingly, legislation must focus clearly on this point in order to enhance environmental protection' (ACEA 1998). In this light, as ACEA argued, two provisions were necessary (ACEA 1998). In the first place, a certification of car-dismantling companies and shredders by independent experts. ACEA stated that certification of dismantlers by authorised experts can reduce the direct administrative burden on Member States and may compensate for the current lack of enforcement in all EU Member States. In the second place, the introduction of a certificate of destruction. Introducing a certificate of destruction is, according to ACEA, the only way to prevent illegal disposal of ELVs, since the last owner would need such a certificate, exclusively approved by an operator to deregister his car.

Car-dismantling companies' opinion on EC's ELV-proposal

Next to the car industry, car-dismantling companies played a role in the development of the Directive. However, their voice was not united and their presence in Brussels power circles was not as clear as the car manufacturers or other industries (e.g. the European Steel Maker Association and the Association of Plastics Manufacturers in Europe) involved (CER 2000). EGARA represented more than 3.000 small and medium-sized companies in Europe. The major points of concern for EGARA were (CER 2000):

The technical requirements and the impact that these would have in the survival of many car-dismantling companies

The measurements of the recycling targets and the potential obligations for reporting and measuring that could be imposed on car-dismantling companies

The possibility to impose responsibility on the last owner to deliver an ELV emptied from all 'surplus' waste (i.e. some ELVs contain a lot of waste that has not been part of the car, for example household wastes, construction waste etc.).

The Proposal ended in the EU-Directive 2000/53/EC. On 21 October 2000, the Directive on ELVs entered into force, and 21 April 2002 was the final date for implementation in the Member States. The objective of the Directive is: (1) to prevent waste from ELVs, (2) to promote the collection of ELVs, (3) to promote re-use and recovery of ELVs (e.g. components) to protect the environment (European Commission 2001). Next, I will describe these three objectives in more detail.

To prevent waste from ELVs

In order to prevent waste from ELVs, the Directive states that car manufacturers and material and equipment manufacturers have to (Article 4):

Endeavour to reduce the use of hazardous substances, when designing cars;

Design and produce cars that facilitate the dismantling, re-use, recovery and recycling of ELVs;

Increase the use of recycled materials in car manufacture;

Ensure that components of cars placed on the market after July 1 2003 do not contain mercury, hexavalent chromium, cadmium or lead, except in the cases in Annex II. (European Commission 2001).

To promote the collection of ELVs

The Directive also introduces provisions on the collection of all ELVs (Article 5). Member States have to take the necessary measures to ensure that economic operators (i.e. producers, distributors, collectors, motor vehicle insurance companies, car-dismantling companies, shredders, recoverers, recyclers and other treatment operators of ELVs (2000/53/EC, article 2, §10)) set up systems for the collection of all ELVs, and make sure that there is adequate availability of collection facilities.

Another important aspect with respect to the collection of ELVs is that Member States have to set up a system, in which the last owner needs a certificate of destruction, in order to be able to deregister his car. Only authorised car-dismantling companies are able to issue a certificate of destruction. Car-dismantling companies will only be authorised, if they comply with a number of requirements aimed at protecting the environment. Furthermore, the last owner of a car should always be able to deliver his car free of charge to an authorised car-dismantling company (‘free take-back’-principle), also in case of the car having a negative market value.

To promote re-use and recovery of ELVs

At the moment, at least 75% of the ELVs weight is recycled (metal content). By the entering into force of the Directive 2000/53/EC, the aim is to obtain the following targets (2000/53/EC, article 7 §2):

No later than 1 January 2006, for all ELVs, the re-use and recovery shall be increased to a minimum of 85% by an average weight per vehicle and year. Within the same time limit the re-use and recycling shall be increased to a minimum of 80% by an average weight per vehicle and year;

No later than 1 January 2015, for all ELVs, the re-use and recovery shall be increased to a minimum of 95% by an average weight per vehicle and year. Within the same time limit, the re-use and recycling shall be increased to a minimum of 85% by an average weight per vehicle and year.

Re-use, recycling and recovery

As stated in article 7 §2 of Directive 2000/53/EC, re-use, recycling and recovery are important aspects. But how to define these terms? Here, three definitions will be given as used in the Directive.

Re-use

Re-use are any operations by which components of ELVs are used for the same purpose for which they were conceived.

Recycling

Recycling is the reprocessing in a production process of the waste materials for the original purpose or for other purposes but excluding energy recovery.

Recovery

Recovery means any of the applicable operations provided for in Annex IIb to Directive 75/442/EEC. Energy recovery means in this respect the use of combustible waste as a means to generate energy through direct incineration with or without other waste but with recovery of the heat.
Closing remarks
The EU ELV-Directive focuses on product systems instead of production facilities. Car manufacturers become responsible for their product, also in the waste phase. This regulation, where manufacturers (financially or physically) are responsible for their products after they have been discarded, is called Extended Producer Responsibility (EPR). EPR requires that manufacturers either take back their products, with the aim of re-using, recycling, or re-manufacturing the products, or delegate this responsibility to a third party. The idea underlying EPR is that manufacturers feel responsible for their products in the waste stage. In the car-chain, the target for EPR is to keep Auto Shredder Residue (ASR) out of landfills and to reduce the number of ELVs, which are disposed of illegally. ASR is about 25% of an ELV's weight, viz. approximately 227 kg (the weight of an average car in the Netherlands in the year 200 was 906 kg (ARN, 2002)), which is approximately 2,7 milliard kg ASR a year in Europe.

End-of-Life Vehicle regulation in the Netherlands and Denmark

In this paragraph, focus will first be on the car chain and its two sub-networks: a production network and a use-, recycling and disposal network (see figure 1). In this article, focus will be on the use-, recycling and disposal network.

In the Netherlands and Denmark, contacts between actors in the two sub-networks are limited. Furthermore, the nature of the contacts in the use-, recycling and disposal network differ; in the Netherlands, these contacts are institutionalised, whereas in Denmark these contacts are characterised by ad hoc initiatives between individual companies.

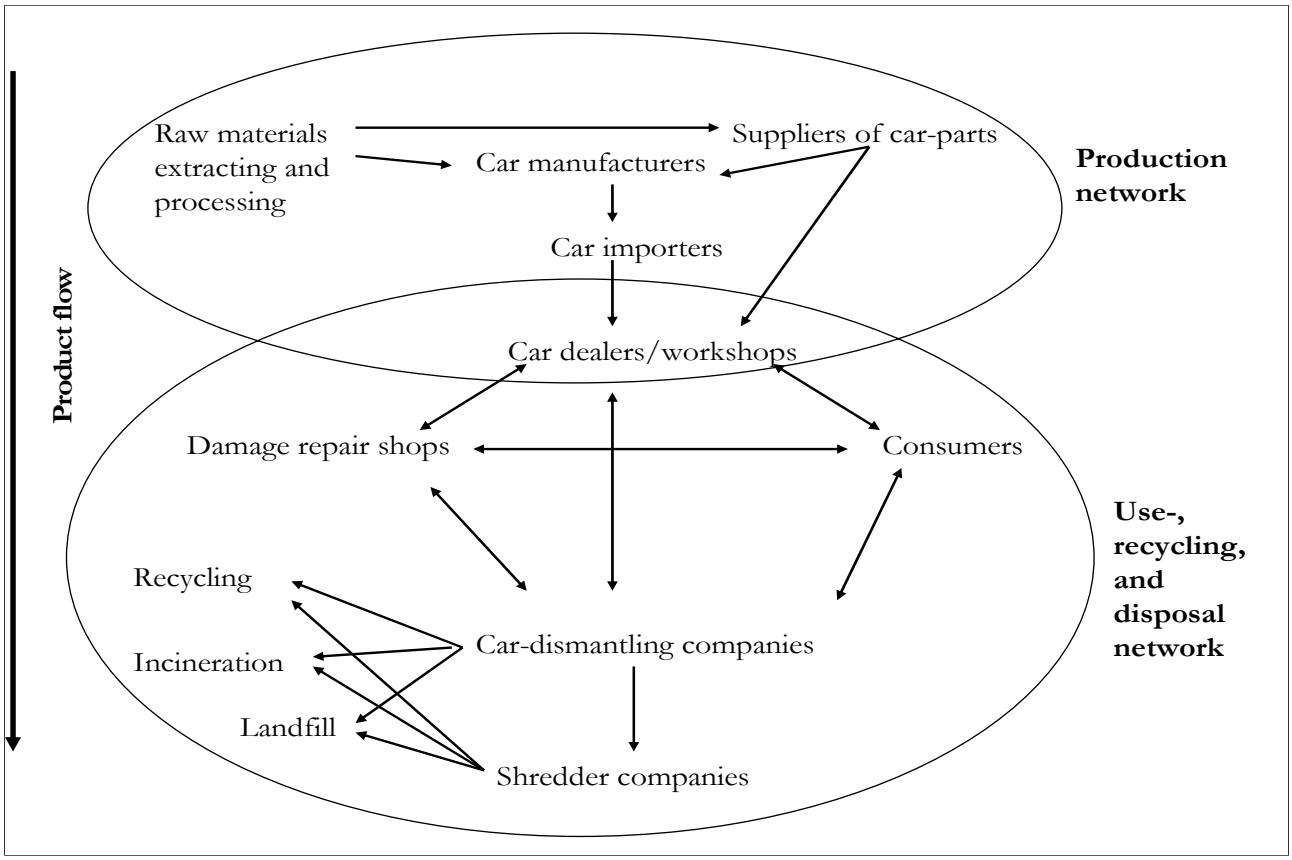

Figure: 1 The car-chain and its two sub-networks (Smink 2002: 163).

Next, focus will be on the ELV-disposal structure in the Netherlands and Denmark. First briefly some information about the problems with auto-recycling in both countries, which they faced in the period prior to the 1990s.

Problems with auto-recycling in the Netherlands and Denmark

Problems with auto-recycling had been that the disposal of ELVs did not happen in an environmental sound way (e.g. odour nuisance, noise, soil pollution, surface water pollution, landscape disfigurement etc.). Secondly, the disposal of ELVs did not happen in an efficient way. The flow of ELVs was problematic, which meant that it was hard to abandon an ELV. Repeatedly, ELVs ended up in nature or at roadsides. But even when ELVs were delivered at a car-dismantling company, wrecks stood often at the dumping ground for more than a year.

In general, two of the main reasons with problems with auto-recycling were insufficient legal instruments and the marginal size of car-dismantling companies (Smink 2002). It was, for example, estimated that Denmark counted more than 600 car-dismantling companies. This was estimated mainly on the basis of mostly incomplete data, as it was difficult to get an overview of the number of car-dismantling companies, as (1) exact data lacked; (2) existing data was rather heterogeneous; (3) it was estimated that some provinces had reported incomplete data and (4) not all car-

dismantling companies in cities had been included (DEPA 1979). Table 1 shows the number of car-dismantling companies and the amount of ELVs at a car-dismantling company in 1972 and 1976.

Danish Environmental Protection Agency (EPA) estimated that about 100 car-dismantling companies had dismantling as their main activity; the other approximately 500 companies had dismantling as additional activity and dismantled often only a part of the ELV. These could for example be scrap-dealers, who traded in second-hand cars and household goods as well as dismantled some ELVs every now and then. Also the Netherlands counted a lot of (very) small car-dismantling companies in the 1970s. Many of these companies stored only 10 to 25 ELVs. This entailed various problems; for example, the ELVs stood too long at dumping grounds, which could cause environmental problems, as the ELVs had often not been dismantled in an environmentally sound way. Several fluids could leak out of the (partly) dismantled ELVs and cause soil and groundwater pollution.

Number of ELVs at a car-dismantling company	**Number of car-dismantling companies**	
	1972	1976
3 – 25 25 – 100 > 100	> 300 ≈ 200 > 100	> 400 ≈ 150 ≈ 150
Total	**> 600**	**> 700**

Table 1: Number of car-dismantling companies and the amount of ELVs in 1972 and 1976 (DEPA 1979: 111, 114).

Many car-dismantling companies in both the Netherlands and Denmark did not have an environmental permit. In the province of Groningen (the Netherlands) for example, only 41 out of 86 car-dismantling companies had an environmental permit (Interview province nl-2 2000), and in the province of Zuid-Holland (the Netherlands) 75% of all car-dismantling companies did not have an environmental permit (Beck 1992). But even if car-dismantling companies had an environmental permit, they did not necessarily comply with environmental regulations, and they did not necessarily have the requested environmental facilities (e.g. floors proof against liquids).

The Netherlands started to deal with these problems in the early 1980s. I will not go into detail with these solutions, but the solutions proposed in a policy document of 1980 were (VoMil 1980: 6):

A decrease in the number of car-dismantling companies to approximately 400 within five years;

Moving car-dismantling companies to industrial areas or closing down car-dismantling companies (state allowance of 50%);

Implementation of environmental facilities by the remaining 400 car-dismantling companies (state allowance of 50%);

Establishment of 150 extra municipal or provincial dumping grounds for ELVs.

In the mid-1990s, the Netherlands started to deal with problems with auto-recycling in a more institutionalised way. This will be described in more detail below.

Denmark started first to work more seriously with problems with auto-recycling in the 1990s (Smink 2002). In 1999, Danish EPA came with a new approach, in which car-dismantling companies were obliged to implement either a certified Environmental Management System (EMS) (according to ISO 14001 or EMAS) or a certified Quality Management System (QMS) (ISO 9002), in order to stay in business. This will be described in more detail below.

Efforts to increase the recycling percentage of ELVs

Here, attention will be paid to the more recent efforts to reduce problems with auto-recycling in both countries and how they have been working on increasing the recycling percentage of ELVs.

The Netherlands

In 1995, the Dutch automobile industry established Auto Recycling Nederland (ARN). Business-associations involved in ARN are the STIBA (car dismantlers), the RAI (car manufacturers and importers), the BOVAG (car dealers and workshops) and the FOCWA (damage repair companies).
Car-dismantling companies can apply for ARN membership, when they have an environmental permit and when a certification body recognised by the Dutch Council for Accreditation approves the company (kind of EMS). Furthermore, a car-dismantling company has to comply with a number of standards that are more stringent than the environmental permit given by the environmental authorities. That is, ARN specifies the methods and sometimes the equipment that companies have to use, in order to become a member. ARN depends on a network of car-dismantling companies, as it is stated in Dutch ELV-Policy, that the last owner of an ELV should not travel more than 50 km, in order to be able to deliver his car. Therefore, a proportional spread of car-dismantling companies over the country is needed. Furthermore, a network of car-dismantling companies is able to make competitive agreements with customers of dismantled materials (e.g. brake fluid, coolant and tyres), as these companies are ensured regularly supply. Car-dismantling companies united in ARN will achieve a waste removal premium for the dismantled products and materials.
ARN car-dismantling companies are contractually obliged to dismantle 19 materials, which are ascertained by ARN. Dismantling these materials is a considerable increase of the number of materials to be recycled. Since the foundation of ARN in 1995, re-use has increased from 75% to 86%. Initially, approximately 250 to 300 kg of materials of each ELV had to be treated as waste and was disposed of, mainly to landfill (ARN 2002). Even though the number of ARN materials has increased, the recycling percentage has stagnated at 86%. This can be explained by the fact that cars contain more synthetic materials and are equipped with more safety conveniences and luxury, such as airbags and air-conditioning. This also means that more and more materials have to be recycled, in order to recycle 86% of a car's weight. Besides, in order to be able to comply with the EU-Directive, the recycling percentage has to be at 95% by 2015. According to ARN, this percentage can only be achieved by applying new technologies at shredder companies, as most possibilities of increasing re-use at car-dismantling companies ran dry (ARN 2000).

ARN has an important influence on the ELV-disposal structure in the Netherlands. In the first place, due to the fact that ARN ascertains which materials car-dismantling companies are obliged to dismantle, and which price they will get for each material. But ARN is not only in charge of maintaining a network of car-dismantling companies and taking care of dismantling procedures and prices. ARN also selects collection companies, recycling companies and probably in the future also shredder companies.

Collection companies are responsible for the transport of ARN-materials from the car-dismantling companies to the recycling companies. Collection companies are selected via a tender procedure and have to meet a number of criteria. A tender has to be submitted per province, material and kilogram. The costs of collection, storage, sampling and transport must be specified separately. Collection companies are periodically controlled by ARN.

Annually, recycling companies in the Netherlands and abroad can submit a tender for the processing of one or more ARN-materials. Before a recycling company can enter into a contract with ARN tests are carried out in order to ensure high-grade recycling. Preferably, one recycling company will have to recycle several materials in order to minimise transport costs. Recycling companies are obliged to submit accurate reports on the quantity and quality of the materials they have taken delivery of and recycled (ARN 2002). ARN car-dismantling companies are obliged to deliver their materials to these by ARN selected recycling companies. Recycling companies do not necessarily be a part of the car chain. From an environmental point of view, it does not matter whether a plastic bumper becomes a new bumper again or a garden chair.

Denmark

As in the Netherlands, Danish car-dismantling companies have to increase the recycling percentage of ELVs, in order to comply with EU-directive. In Denmark, focus is mainly on the environmental performance of individual car-dismantling companies. In 1999, the Act on ‘Environment Premiums and Reimbursement in connection with Dismantling and Scrapping of Vehicles’ was adopted (Act number 372 of June 2, 1999 (Lov om Miljøbidrag og Godtgørelse i forbindelse med Ophugning og Skrotning af Biler). The purpose of the act is to provide a financial basis for reimbursement to car owners in connection with delivery of ELVs for waste management operators. With the new act entering into force, car-owners have to pay an annual environmental premium of € 12, which is collected by insurance companies together with the premium for the compulsory liability insurance. In this way, no car owner can dodge paying the premium.
The insurance companies pay the environment premium into the recycling fund of the central customs and tax authorities. Car-owners, who deliver a vehicle for recycling to an authorised car-dismantler, will receive a certificate of destruction. On the basis of this certificate, they will get € 237 from the recycling-fund.

The authorisation of car-dismantling companies is regulated in a Statutory Order on ‘Handling of waste in the form of engine driven vehicles and waste factions of these’ (Statutory Order 480 of June 19 2002. Bekendtgørelse nr. 480 af 19. juni 2002 om håndtering af Affald i form a motordrevne køretøjer og affaldsfraktioner herfra. This Statutory Order has replaced Statutory Order nr. 860 of November 29 1999). An authorised car-dismantling company has to have a certified EMS (ISO 14001 or EMAS) and/or a certified QMS (ISO 9001 or ISO 9002) in order to be able to regis-

ter at Danish EPA. The aim is to strengthen existing regulation, in such a way that harmful waste to the environment is dealt with in an environmental sound manner. This Statutory Order describes in detail which materials and products have to be dismantled, how they have to be dismantled, and how they have to be transported. This means that the environmental burden of waste has to be reduced and that re-use and recycling of waste components have to be increased.

The Environmental Facility for Vehicles (Miljøordning for Biler, MOB) is managing the new regulations; MOB keeps information on, how many ELVs have received a scrapping fee and, therefore, have been dismantled at a certified car-dismantling company. MOB estimates that authorised car-dismantling companies dismantle about 84% of the ELVs in Denmark (DEPA 2002b). To summarise, the new ELV-regulations – together called Scrappage Package – contain three main aspects:

A Statutory Order informs car-dismantling companies which materials and products have to be dismantled;
Car-dismantling companies have to implement a certified EMS (ISO 14001 or EMAS) or a certified QMS (ISO 9002);

Annually, car-owners have to pay € 12 to a scrapping fund.

Differences in the Dutch and Danish approach

Even though both the Netherlands and Denmark have to implement the same EU-regulations, the regulatory approach chosen differs considerably. This has had consequences for – inter alia – the recycling percentage of ELVs.

The main difference between the Netherlands and Denmark, with regard to ELV-regulation is the point of time when developments got started, which might also be the reason, why the recycling percentage in the Netherlands is higher than in Denmark. Table 2a and 2b show the differences in the recycling percentage in resp. Denmark and the Netherlands.

Furthermore, the network relations between car-dismantling companies and other actors in the use-, recycling and disposal network in the Netherlands are institutionalised, whereas the Danish network is characterised by ad hoc initiatives between individual companies (Smink 2002). As described above, ARN depends on a network of car-dismantling companies, in order to make competitive agreements with customers of dismantled materials and to improve relationships with these actors. A network of companies is better able to ensure a regular supply of used car-parts, which makes it possible for these companies to keep contacts with other actors in the use-, recycling and disposal network (Smink 2002).

In Denmark, co-operation between several actors in the use-, recycling and disposal network is more on an ad hoc basis. For example, two internet-based systems have been established to encourage the sale of used car-parts. The business-association for Danish car-dismantling companies (Dansk Autogenbrug, DAG) has tried to ensure a certain quality of the used car-parts by implementing a code system. This is a positive development, as this might be of interest for other

market actors, for example insurance companies or consumers. The coding system guarantees a certain standard, which might persuade potential customers to buy used car-parts, which will increase the recycling percentage of ELVs. Another reason, why the recycling percentage in Denmark is lower than in the Netherlands might the height of wages. The wages in Denmark are considerably higher than in the Netherlands. Consequently, it is more expensive to dismantle, stock and sell used car-parts compared to the sale of brand new parts. This does not encourage the use of used car-parts (Smink 2002).

	1997 (absolute)	**1997 (%)**	**2000 (absolute)**	**2000 (%)**
Car weight (average)	879 kg	100%	906 kg	100%
Metals (assumption)	659 kg	75%	679 kg	75%
Other materials	- kg		0 – 46 kg	0 – 5%
Recycling	**659 kg**	**75%**	**679 – 725 kg**	**75 – 80%**
Remaining	220 kg	25%	181 – 227 kg	20 – 25%

Table 2a: Estimated treatment of ELVs 1997-2000 in Denmark (ARN 2002; DEPA 1992; DEPA 2002a).

	1997 (absolute)	1997 (%)	1998 (absolute)	1998 (%)	1999 (absolute)	1999 (%)	2000 (absolute)	2000 (%)
Car weight (average)	879 kg	100%	887 kg	100%	896 kg	100%	906 kg	100%
Metals (assumption)	659 kg	75%	665 kg	75%	672 kg	75%	679 kg	75%
ARN materials	96 kg	10,9%	97 kg	10,9%	99 kg	11%	100 kg	11%
Recycling	**755 kg**	**85,9%**	**762 kg**	**85,9%**	**771 kg**	**86%**	**779 kg**	**86%**
Remaining	124 kg	14,1%	125 kg	14,1%	125 kg	14%	127 kg	14% kg

Table 2b: Recycling percentage ELVs 1997-2000 in the Netherlands (ARN 2002).

Conclusion

Both the Netherlands and Denmark have implemented EU directive 2000/53/EC. In both countries car owners need a certificate of destruction when disposing of their car; in both countries car-dismantling companies have to be authorised to issue the certificate of destruction; the free take-back principle is in the Netherlands based on a levy system: everybody who applies for a car registration for the first time has to pay a waste disposal fee of € 45; in Denmark the last owner has to pay for treatment (approx. €106-133), but receives fund compensation (€200) when presenting certificate of destruction.

However, the recycling percentage of ELVs in both countries differs. The recycling percentage of ELVs in the Netherlands is 86%. According to ARN, focussing on new technologies at shredder companies is the only way to increase this percentage, as most initiatives at car-dismantling companies ran dry. Registration of dismantled materials in Denmark is not as detailed as in the Netherlands. Nevertheless, it is to be expected (see also footnote 19) that the recycling percentage in Denmark is approximately 75-80%. So far about where we are.

Finally, some thoughts about 'where do we need to be'? In principle, this question is very easy to answer: in a situation in which re-use and recovery of an ELV is at least 95% and re-use and recycling is at least 85%. Therefore, it is more interesting to reflect upon the question: how do we reach this situation? It is impossible to answer this question here, but I think it is relevant to look at the following aspects:

To what extent are recycling partnerships (i.e. partnerships between car-manufacturers and car-dismantling companies) a solution to increase to recycling percentage of ELVs?

Should focus be on national or international systems?

To what extent is brand specific dismantling a solution?

To what extent are contacts between the automobile industry and other trades a solution?

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